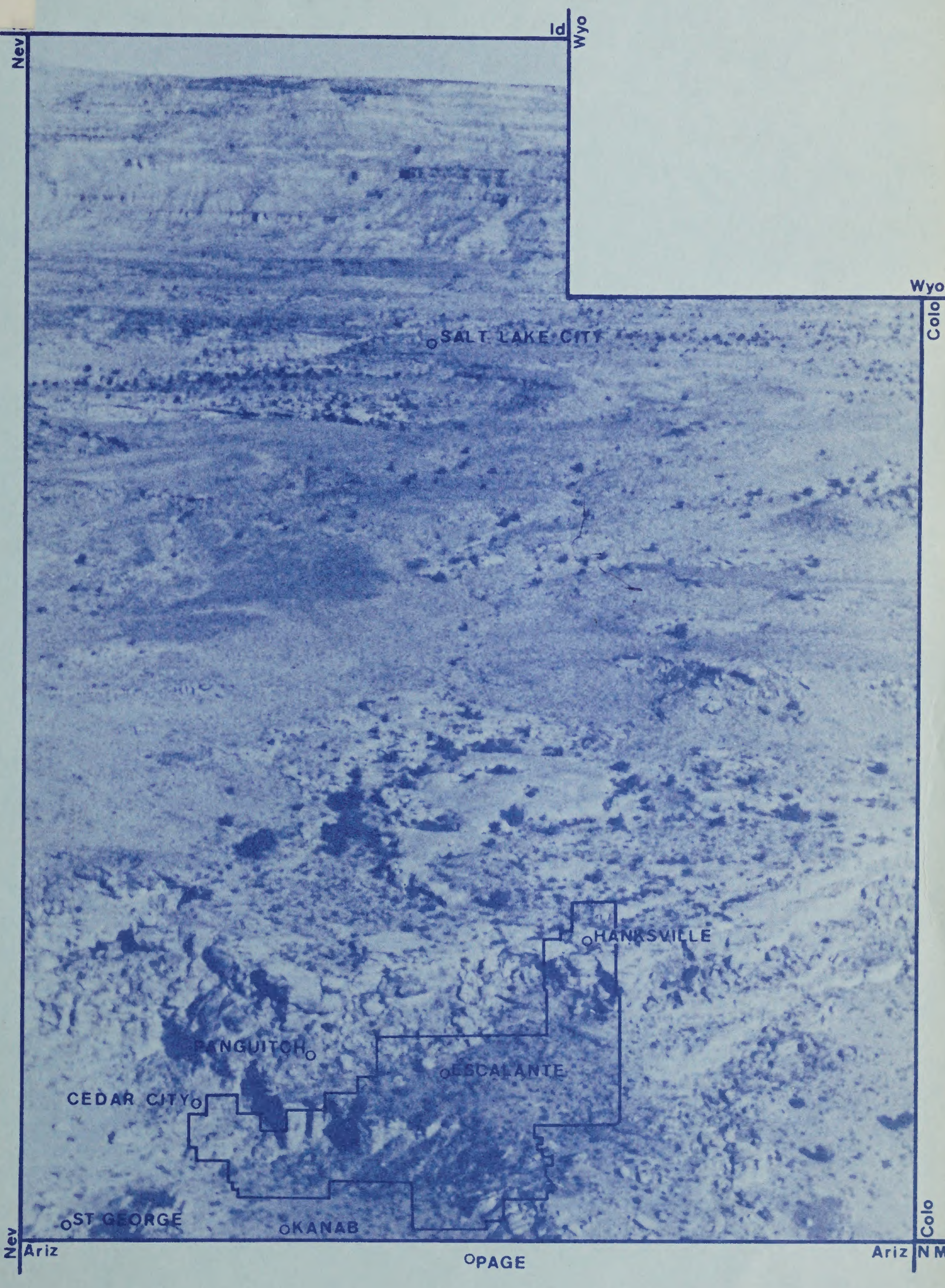
Development of Coal Resources in Southern Utah

Part 1 Regional Analysis

DRAFT

ENVIRONMENTAL STATEMENT



Cover Photograph: View of the southern part of the Kaiparowits Plateau, looking north toward Fourmile Bench

DEPARTMENT OF THE INTERIOR

DRAFT

ENVIRONMENTAL STATEMENT

DEVELOPMENT OF COAL RESOURCES

IN

SOUTHERN UTAH

Prepared by the

DEPARTMENT OF THE INTERIOR

H. William Menard

Director, U.S. Geological Survey

DEVELOPMENT OF COAL RESOURCES
IN SOUTHERN UTAH

VOLUME CONTENTS

CONVERSION FACTORS

The following factors may be used to convert the U.S. customary units to metric units.

Multiply U.S. customary unit	By	To obtain metric unit
inch (in)	25.4	millimeters (mm)
foot (ft)	.3048	meter (m)
acre	.4047	hectare (ha)
square mile (mi^2)	2.590	square kilometers (km^2)
gallon per minute (gal/min)	.06309	liter per second (L/s)
acre-foot (acre-ft)	.001233	cubic hectometer (hm^3)
cubic foot per second (ft^3/s)	.02832	cubic meter per second (m^3/s)

SUMMARY

Draft (x) Final ( ) Environmental Statement

Department of the Interior, U.S. Geological Survey

1. Type of Action: Administrative (x) Legislative ( )

2. Brief Description of Action: The proposed actions are based on three formal proposals for mining Federal coal in the Southern Utah region. This environmental statement is developed in two parts: an analysis of cumulative impacts of potential coal developments in the region, and specific mining and reclamation plan analyses. Involved are:

A. Approval of three mining and reclamation plans on existing leases.

B. A projected level of development that includes the Allen-Warner Valley (AW-V) energy system, a major 2,500 megawatt electric power generation proposal.

No land-use applications for facilities associated with mining and reclamation plans have been submitted.

Of the projected production of 12 million tons per year (mty); 10.5 mty would be supplied by the Alton mine and 1.5 mty from other proposed mines on the Kaiparowits Plateau and/or from potential development on State land. 10.5 mty would be required for the A-WV project.

3. Summary of Environmental Impacts by 1990:

A. Land surface on 17,149 acres would be disturbed; the Alton mine would affect 8,300 acres. Subsidence could affect about 3,000 acres on the Kaiparowits Plateau. Fractures, depressions and surface buckling may accompany the subsidence.

B. About 250 million tons of coal would be extracted. About 65 million tons not recoverable by current methods would be left in place.

C. Some fossils would be destroyed; others could be revealed.

D. Soils on 19,000 acres would be disturbed by mining, mine facilities, transportation systems, powerlines, water projects, power-plants, and community development. On-site erosion rates could increase by an average of 10 cubic yards per acre per year.

E. Water quality may be lowered, mainly in the strip mine area near Alton. Total dissolved solids would increase. Ground-water use could decrease the yield of springs and wells.

F. Air quality would be lowered, primarily total suspended particulate (TSP), in the vicinity of the mines and associated unpaved roads.

The eastern portion of the Alton lease area is presently being analyzed to determine if Class I Prevention of Significant Deterioration TSP standards wold be violated at Bryce Canyon National Park.

G. The present visual quality of the landscape would be changed as a result of mining and the ancillary transportation and transmission facilities. Dust could reduce the visual range to less than 3 miles around the Blue and Kaiparowits No. 5 mines and to 17 miles near the Alton strip mine.

H. Vegetation on 9,400 acres would be destroyed by mining, construction of ancillary facilities and urban development. This vegetation would have provided 64 AUM's per year of grazing for domestic livestock for an average 30-year period.

I. About 9,000 acres of wildlife habitat would be lost for the duration of the project, and about 2,000 would be permanently lost to urbanization, recreational homes and roads.

J. About one half of the regional increase in population, from 46,500 in 1970 to 66,950, would be concentrated in Kane and Garfield Counties.

K. The increased population would require about 565 acre-feet of water annually for domestic and public supply purposes.

L. Approximately 222 acres of irrigated cropland would be removed from production if water needed for domestic and public supply were reallocated from existing agricultural water use.

M. The existing labor force mix would change. The social and cultural characteristics of workers migrating into the area may contrast sharply with those of the area's "current" residents, thus possibly leading to social conflicts.

N. Competition for labor would adversely affect existing area businesses and rising incomes would spur competition for goods, services, and housing. Those persons on fixed incomes could suffer.

O. The quality and quantity of some municipal and local services may decline.

P. Substantial demands would be placed on transportation systems. The 115 miles of roads needed to provide direct mine access would require 530 acres of land.

4. Alternatives Considered: The alternatives discussed relate to the Secretary's possible decisions on mining and reclamation plans under consideration. The production level alternatives provide a basis for evaluation of areas of environmental concern or impact sensitivity. Three scenarios are presented. The low-level scenario is essentially the same as the no-action alternative and projects production of 1 million tons of coal by 1990. The medium level scenario projects a production of 29.3 mty by 1990. The high-level scenario projects a production of 46 mty by 1990. Although the Secretary is not proposing a particular level of production, he can consider actions that will allow Federal coal to be available under environmentally acceptable conditions.

5. Comments on the draft environmental statement have been requested from various agencies, state clearing house, and interest groups. See Summary, Attachment I, and Chapter 9.

6. Date draft statement was made available to EPA and the public:

SUMMARY, ATTACHMENT 1

Comments have been requested from the following:

Department of the Interior:

Bureau of Mines
Bureau of Reclamation
Heritage Conservation and Recreation Service
National Park Service
Office of Surface Mining

Other Federal Agencies:

Advisory Council on Historic Preservation
Department of Agriculture
  Soil Conservation Service
  USDA Forest Service
Department of Commerce
Department of Energy
Department of Health, Education, and Welfare
Department of Housing and Urban Development
Department of Labor
  Mining Safety and Health Administration
  Occupational Safety and Health Administration
Department of Transportation
Environmental Protection Agency
Federal Energy Regulatory Commission
Interstate Commerce Commission
Mountain Plains Federal Regional Council
National Historic Preservation Council
Office of Economic Opportunity
Office of Management and Budget
Water Resources Council

State and Local Agencies:

State of Utah Clearing House
Four Corners Regional Commission
Washington County Commissioners
Iron County Commissioners
Kane County Commissioners
Garfield County Commissioners

[illegible] STATEMENT

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Advisory Council on Historic Preservation
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Soil Conservation Service
Forest Service
Department of Commerce
Department of Energy
Department of Health, Education, and Welfare
Department of Housing and Urban Development
Department of Labor
Mining Safety and Health Administration
Occupational Safety and Health Administration
Department of Transportation
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Interstate Commerce Commission
[illegible] Regional Commission
[illegible]
Office of Economic Opportunity
Office of Management and Budget
Water Resources Council

State and Local Agencies:

State of Utah Clearinghouse
[illegible]
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PART I

REGIONAL ANALYSIS

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DEVELOPMENT OF COAL RESOURCES

IN SOUTHERN UTAH

DRAFT ENVIRONMENTAL STATEMENT

CHAPTER I: DESCRIPTION OF PROPOSED ACTIONS

A. INTRODUCTION

1. AREA

Regional Environmental Impact Statements (EIS) are being prepared for the southern Utah and central Utah coal fields under the leadership of the U.S. Geological Survey (GS)(fig. I-1). The Southern Utah Regional Coal Environmental Impact Statement (EIS) concerns a broad area of southern Utah and includes the Henry Mountains, Kaiparowits Plateau, Alton, and Kolob coal fields. These coal fields have been idle in recent years, and past production was limited to small local markets. The EIS boundaries comprise most of the proposed coal developments and associated actitivites in southern Utah and include most of the area of expected major direct and indirect impact (fig. I-2). There is no proposed coal production from the Harmony Field which is outside the regional EIS boundary and none is expected within the timeframe of this statement.

Detailed plans have been submitted to the GS for approval to develop federally-owned coal under lease in the Kaiparowits Plateau and Alton coal fields. Plans and land use applications have been filed with the Bureau of Land Management (BLM) for the proposed Allen-Warner Valley Energy System (A-WV). This consists of steam-electric power generation stations near St. George, Utah and Las Vegas, Nevada and associated transportation and electrical distribution facilities. The power generation stations would consume coal mined from the Alton coal field and transported to their localities by coal-slurry pipeline. These detailed proposals and other possible developments covered by the EIS share common reclamation problems, administrative boundaries, and are in areas that are economically interdependent.

Impacts that extend beyond the delineated boundaries of the EIS region are analyzed to the extent that they are significant to the region and are more associated with the proposed actions than with other actions outside the region. Elements having broader geographic impact include social and economic factors, air quality, transportation systems, and recreation.

2. SCOPE

This environmental statement is an analysis of individual and cumulative impacts of coal developments proposed for Federal approval

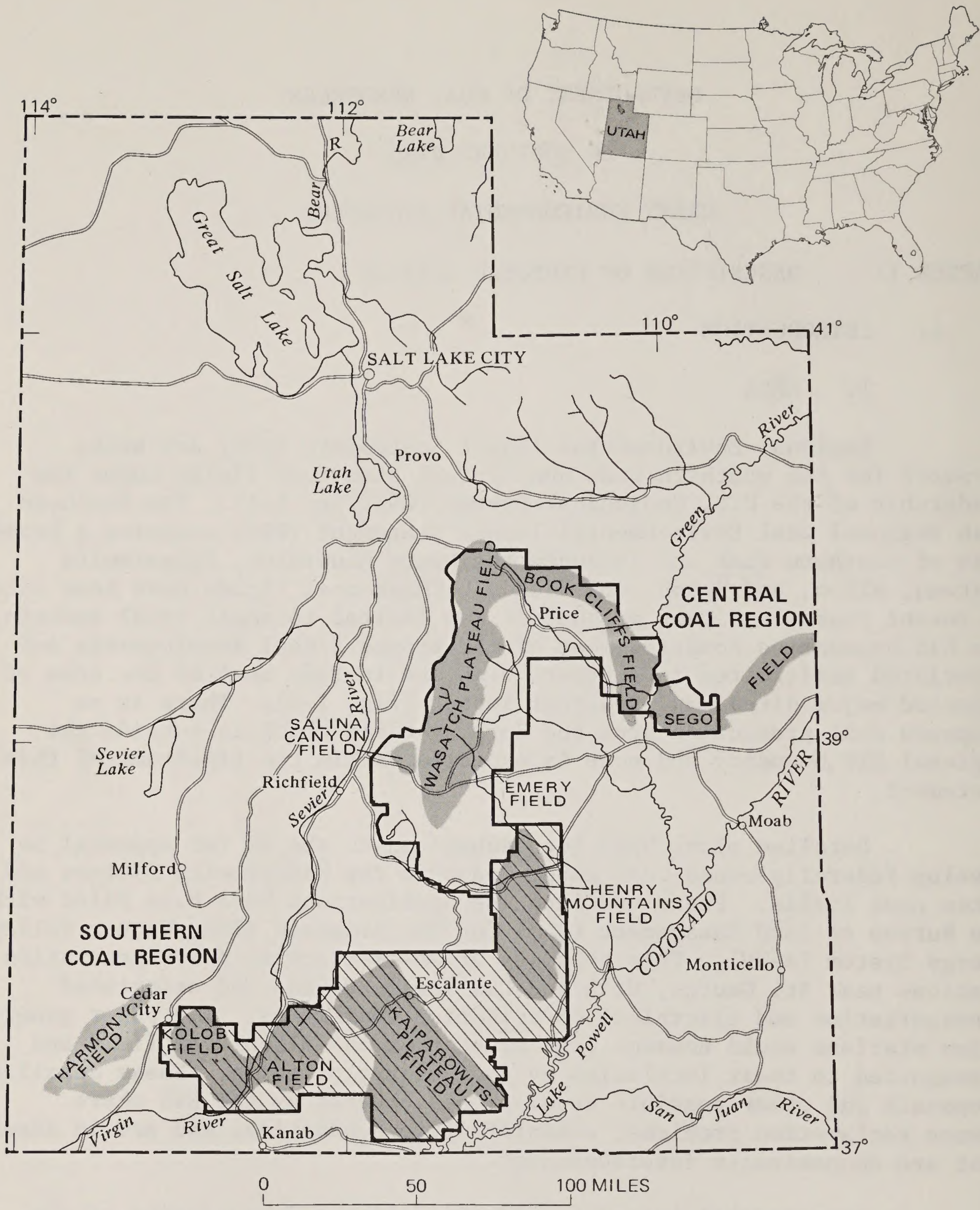

Figure I-1. --Index map showing southern and central Utah EIS regions and principal coal fields.

(table I-1), and their associated off-lease actions for which right-of-way applications have been submitted. The basis for analysis also includes production from future development of private coal mines requiring no Federal authorizations, and other coal related potential developments.

The major analysis in the body of this statement is based on a projected coal production level scenario of 12 million tons per year (mty) by 1990. The production level is dependent on Federal approval of mining and reclamation plans on existing Federal leases. However, the Secretary of the Interior is not proposing a production level for coal in this region. Instead he is considering appropriate actions to insure that Federal coal is available under environmentally acceptable conditions and as-needed to meet market demands and the energy needs of the nation.

The projected level also includes the Allen-Warner Valley Energy System (A-WV), a major 2,500 megawatt capacity power-generation proposal. A separate ES for this project is being prepared by BLM. The higher level production scenarios in chapter VIII include two more power generation proposals and several railroad and coal slurry pipeline proposals.

The projected production of 12 mty was chosen to meet the requirements of the A-WV proposal (10.5 mty) to be supplied by the Alton mine. An additional 1.5 mty would come from two of the seven proposed mines on the Kaiparowits Plateau (table I-1) and (or) from potential development on State land. The 1.5 mty represents what could reasonably be transported from the Plateau with upgrading of the current road system. Three production scenarios are analyzed in chapter VIII: (1) low production level of less than 1 mty, (2) medium production level of 29.3 mty based on approval of all detailed mining proposals, and (3) high production level of 46 mty based on; full production from detailed and preliminary mining proposals, and possible production from other Federal and State lands under lease.

The EIS does not propose new coal leasing nor does it commit the Secretary of the Interior to a new coal-leasing program or to the issuance of new coal leases. Additionally, any future coal-related actions on Federal lands in central Utah beyond those proposed and analyzed in this statement will require additional environmental assessment prior to granting of permits.

Development of alternative sources of energy, energy conservation, Federal development of the coal, and emphasis on coal development in other regions of the United States are considered more appropriately evaluated on a program rather than a regional basis. This was done in the previous Interior Department coal programmatic statement and will be updated and revised as necessary in the new programmatic statement now underway.

Table I-1.--Proposed actions--mining and reclamation plans

Company	Mine name and type	Area (acres)		1990 potential production (millions of tons)	
		Federal	State and private	Mining plan total mid-level scenario	Projected level scenario
El Paso Coal Co.----	Red and Blue (underground).	27,659	12,887	6.8	[1]0.5
Mono Power Co. et al.	Kaiparowits Nos. 1-5 mines (underground).	40,277	7,499	12.0	[2]1.0
Nevada Power Co. and Utah International, Inc.	Alton (surface)	26,534 7,160	[3]2,101 1,760	10.5	10.5

[1] Blue mine.
[2] Kaiparowits No. 5 mine.
[3] Privately owned, 960 acres; State-owned, 800 acres (approximate).

3. TIMEFRAME OF ANALYSIS

This statement analyzes the impacts of potential coal development to the year 1990 (table I-2). The date was arbitrarily chosen to allow reasonably accurate predictions and to ensure uniformity between the several regional coal EIS analyses being made in other parts of the nation. However, most of the detailed proposals anticipate a much longer life (table I-2) based on estimated coal reserves and planned annual production (see table I-1). In many cases the residual impacts of roads and powerlines are not analyzed. The useful life of these facilities may extend far beyond the mine life; however, the land managing agency cannot now identify those to be retained.

It is anticipated that none of the proposed mines will be producing coal by 1980 due to uncertainties in receiving approvals from various Federal and State agencies and the lead time required to acquire equipment and construct surface facilities. These properties could be producing by 1985. The 1985 and 1990 projections are based on project approvals by 1980.

4. AGENCY ROLES IN PREPARATION

The statement is being prepared by an interagency task force under the leadership of the Geological Survey. Other participating agencies are the Forest Service, Department of Agriculture; Bureau of Land Management; Bureau of Mines, and Fish and Wildlife Service, Department of Interior; and the Interstate Commerce Commission.

5. FUTURE NATIONAL ENVIRONMENTAL POLICY ACT (NEPA) REVIEW POINTS

Major environmental review that may be required of both approved and preliminary projects on Federal lands include:

1. Future changes in approved mining and reclamation plans.

2. Future requests for right-of-way permits or coal lease applications which meet short-term standards would have to be reviewed.

3. The Surface Mine Control and Reclamation Act requires mining permits to be reviewed and renewed at a minimum of every 5 years.

4. Department of Energy (DOE) - under the Act of 1977, DOE was authorized to set coal production rates on Federal coal leases, and establish diligence requirements for each lease. Guidelines and procedures are being developed for coordination of DOE's responsibilities with those of DOI.

Table I-2.--Project development time frame

[Coal projected level, in millions of tons per year]

Company	Proposed project	Project development 1980	1985	1990	Recoverable reserves	Project life (years)
El Paso Coal Co.	Blue mine-------	0	0.35	0.5	[1]6.0	12
	Red mine--------	0	0	6.3	[1]184.0	39
Mono Power Co. et al.	Nos. 1-5 mines--	0	.65	12.0	[1]534.5	44
Nevada Power Co. and Utah International, Inc.	Alton strip mine.	0	5.0	10.0	212	[2]23
Nevada Power Co. et al.	Allen-Warner Valley power project[3].	--	--	--	--	40

[1] 50 percent estimated recovery.
[2] 9.25 mty average.
[3] Site specific environmental analysis being prepared by BLM.

5. Preference-Right-Lease Application Status Review - preference-right-lease applicants were required to prepare an initial showing indicating evidence in technical and environmental statements to be prepared jointly by BLM and GS.

Recent interpretation of the Mineral Leasing Act of 1920 has determined that areas of Federal coal under preference-right-lease application cannot be leased if there exists, on that area, a prior valid existing mining claim under the Mining Act of 1872. Preference-right-lease applications are required to submit abstracts of any mining claims found on their application area by March, 1978.

On September 27, 1977 the Department of Interior was enjoined from issuing any new coal leases until a supplemental coal programmatic environmental statement correcting the deficiencies of the original statement has been issued in final form and a new coal management program has been developed. Therefore, the existing preference-right-lease applications cannot be issued until this injunction is lifted.

B. SPECIFIC PROPOSED ACTIONS

1. APPLICATIONS

Three mining and reclamation plans have been submitted to USGS under 30 Code of Federal Regulations (CFR) 211 of May 1976 (table I-1). Each of the proposed mines is a new operation involving development of issued Federal leases. The mining and reclamation plans included in this statement were submitted for review prior to the promulgation of initial regulations (30 CFR 700) required under Section 502 of the Surface Mining Control and Reclamation Act of 1977 (PL 95-87) and have not been officially reviewed for compliance therewith. Therefore, the mining and reclamation plans may not reflect the requirements of the initial regulations. However, in this statement the applicable initial regulations are considered as a required Federal mitigating measure.

The mining and reclamation plans have been returned to the operator together with a request that they be revised in accordance with the applicable initial regulations. As soon as the mining and reclamation plans are revised and returned to the U.S. Geological Survey, they will be evaluated with the Office of Surface Mining to determine compliance with the requirements of Federal regulations at 30 CFR 211 and 30 CFR 700. The mining and reclamation plans cannot be approved until they conform to all applicable requirements.

No land use applications for facilities associated with mining and reclamation plans have been submitted.

2. REQUIRED AUTHORIZATIONS

a. U.S. Geological Survey (GS)

The Area Mining Supervisor of GS must approve the mining and reclamation plan prior to any commencement of mining operations by the company.

b. Bureau of Land Management (BLM)

The BLM or other surface managing agencies must concur with the mining and reclamation plan as pertains to surface management before approval is granted by GS. BLM is also responsible for granting various rights-of-way for ancillary facilities such as access roads, powerlines, communication lines, and railroad spurs on public lands.

c. State of Utah

The Division of Oil, Gas and Mining and the Office of Surface Mining are preparing rules and procedures to implement the applicable initial regulations of the SMCRA.

C. COAL DEVELOPMENT THROUGH 1990

1. EXISTING COAL DEVELOPMENT

There is no existing coal development within the boundaries of the Southern Utah Coal EIS.

2. PRODUCTION PROJECTIONS

a. Federal Coal

1. <u>Proposed Actions</u>

Projected production from site specific mining proposals is shown on table I-1. This represents full potential production by 1990 if mining plans are approved and if there is a market for the coal. It is unlikely that any of these mines will be in production by 1980. Projected production by 1985 is dependent upon projects being approved by 1980.

2. <u>Projected Lease Development</u>

There are seven coal mining proposals involving Federal leases and preference-right-lease applications (PRLA). These are all preliminary proposals and require no Federal action at this time. The plans were submitted to give an indication of company long-range planning and as a means of assessing potential environmental impacts of a greatly expanded coal production potential. There are no "short-term criteria" lease applications. Twenty-two preference-right-lease applications are on file.

b. Non-Federal Coal

There is one mining proposal on State lands (5M Corp.) pending approval by the State Board of Oil, Gas, and Mining. Scattered tracts of State lands are involved in the detailed and preliminary mining plans.

3. ANCILLARY FACILITIES

Preliminary proposals for off-lease ancillary facilities have been submitted by the mining companies in support of the detailed mining and reclamation plans. These proposed facilities would provide access, electric power and coal transportation, etc. However, no right-of-way applications have been filed. These preliminary proposals are discussed in chapter VIII under the medium and high production level scenarios.

D. COAL PRODUCTION SCENARIOS

The annual production levels projected to 1990 that form the basis for this analysis are 0 (less than 1 mty), 12 mty, 29.3 mty, and 46 mty (table I-3).

1. LOW PRODUCTION LEVEL

The low production level scenario contemplates less than 1 mty production from State and private lands. This production level is analysed in chapter VIII.

2. PROJECTED PRODUCTION LEVEL

The annual production of 12 mty is the projected level evaluated in detail in chapters III to VII of this statement. It is based on an average full production of 10.5 mty from the Alton mine to meet the fuel requirements of the proposed Allen-Warner Valley power-generation stations, and 1.5 mty from the Kaiparowits Plateau coal field. The 1.5 mty would be from the Kaiparowits No. 5 mine (1 mty), the Blue mine (0.5 mty) (table I-2) and (or) from State or private land. The projected level is chosen to coincide with limitations imposed by existing or detailed proposed transport systems. The coal from the Alton mine is to be transported by a proposed coal-slurry pipeline and that from the Kaiparowits Plateau by truck.

The facilities proposed at the projected level of development are summarized on table I-4, by number and type of facility, water and acreage requirements, and as appropriate, the mileage.

Road upgradings are inferred in the site specific proposals, but no main highway upgradings are proposed as a part of the projected level. Of these, the most important to coal development at the projected

Table I-3.--Aggregate coal production projections

[Data are in million tons per year (mty)]

Production scenarios	1980	1985	1990
Low level------------------	0	6.0	12.0
Projected level -----------	0	0	0
Mid-level -----------------	0	22.0	29.3
High-level ----------------	0	28.0	46.0

level is the upgrading of the road providing access to the Kaiparowits Plateau from Glen Canyon City. This road would cross a corner of the Glen Canyon National Recreation Area to the Kaiparowits No. 5 minesite, and continue north to the Blue mine.

3. MEDIUM PRODUCTION LEVEL

The medium production level scenario of 29.3 mty is the sum of full production proposed in three detailed mine plans (Alton, Kaiparowits 1-5, Red and Blue mines). This production level is analysed in chapter VIII.

4. HIGH PRODUCTION LEVEL

The production level of 46 mty comprises full production proposed in the detailed and preliminary mine plans, including Federal, State and private lands. Also included in this analysis are powerplants preliminarily proposed near Escalante, and several railroad and coal-slurry line proposals. This production level is analysed in chapter VIII.

E. ALLEN-WARNER VALLEY ENERGY SYSTEM

The proposed Allen-Warner Valley Energy System (fig. I-3) is a cooperative venture involving Nevada Power Company, Utah International, Inc., Southern Pacific Pipelines, Inc., the cities of Los Angeles, Calif. and St. George, Utah, and the Washington County (Utah) Water Conservancy District. The Bureau of Land Management is making an environmental analysis of this proposal. It will be submitted later under separate cover. Figure I-3 indicates location of various components. The following is a brief summary of the project components:

1. COAL MINING AND PROCESSING

Utah International proposes to develop Federal, State and private leases in the Alton coal fields of Kane County, Utah held by Utah International, Inc. (UII) and Nevada Power Co. (NPC). Coal production would involve contour strip mining on about 8,200 acres. Mined coal would be trucked for distances up to 35 miles to a processing facility (1,826 acres), located at Bald Knoll, Utah. Here the coal would be crushed, screened, cleaned, ground, and mixed with an equal amount of water (by weight) to form slurry. Approximately 8,284 acre-feet of water per year needed for the coal slurry would be obtained from a nearby well field pumping about 10,000 acre-feet annually from the Navajo Sandstone Formation.

2. TWO COAL SLURRY PIPELINES

One line would travel 73 miles from Bald Knoll to the Warner powerplant and would have the capacity to carry 2.5 million tons of coal

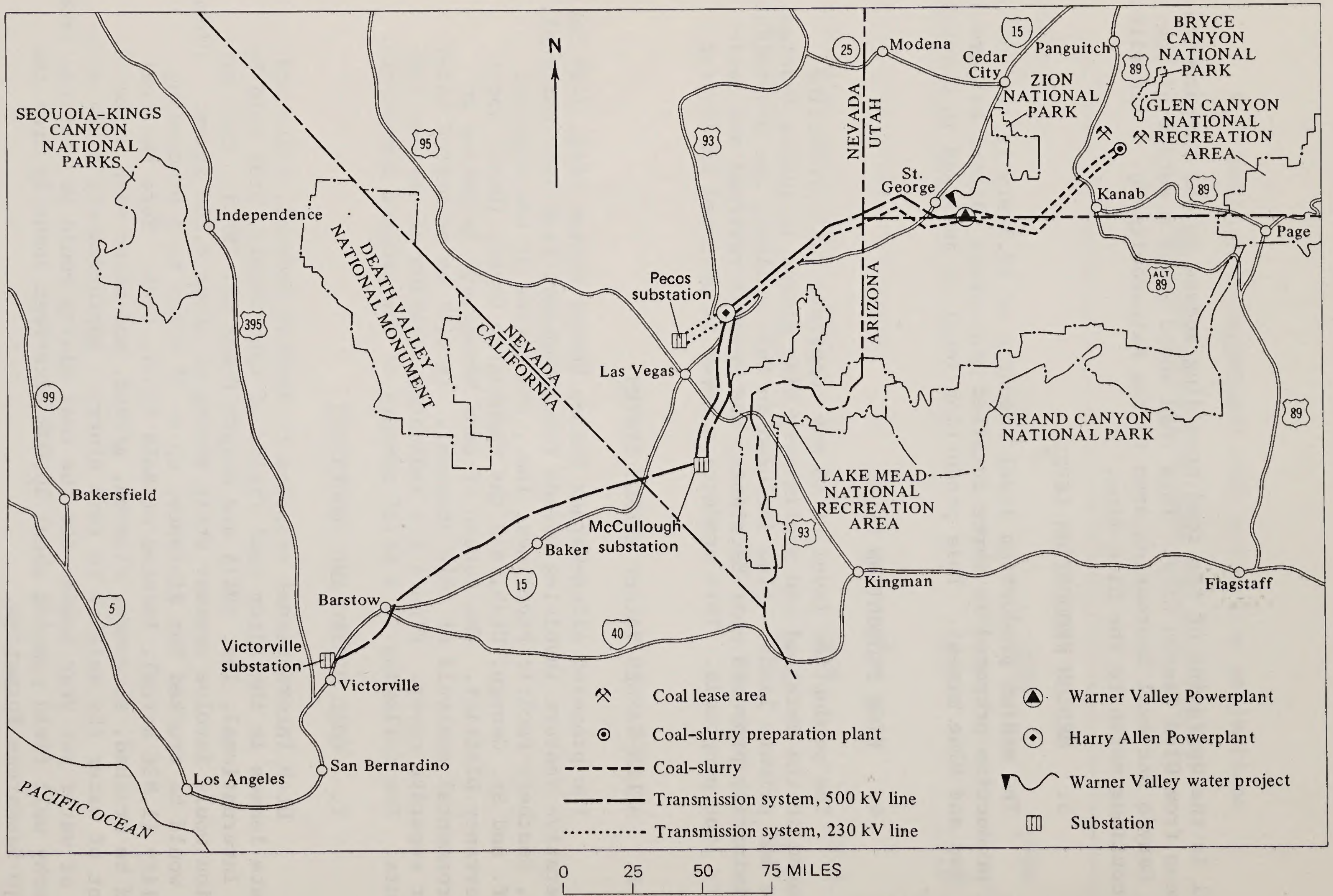

Figure I-3.--Map showing proposed Allen-Warner Valley energy system.

annually. At the powerplant, the coal would be dewatered and partially dried; the slurry water would be used in the powerplant operation. The other pipeline, having the capacity to carry 9.1 million tons of coal per year, would run 110 miles from Bald Knoll to the Allen powerplant where the above process would be applied to the slurried coal and water.

3. WARNER VALLEY POWERPLANT

Proposed as a 500-megawatt (MW) plant located about 13 miles southeast of St. George. Water for cooling would be supplied by the proposed Warner Valley reservoir and the coal slurry.

4. HARRY ALLEN POWERPLANT

This 2,000-MW plant would be located about 25 miles northeast of Las Vegas, Nev., on a dry lake bed. Cooling water would come from the Clark County Advanced Waste Water Treatment Facility and the coal slurry.

5. ELECTRICAL TRANSMISSION LINES

Although a complete transmission system proposal is not available, four route segments have been proposed: (1) one line (152 miles long) from the Warner plant through Mohave County, Ariz., to the existing McCullough substation 25 miles south of Las Vegas; (2) a line (48 miles long) from the Allen plant to the McCullough substation; (3) two lines (16 miles each) from the Allen plant to the existing Pecos substation 8 miles north of Las Vegas. From the McCullough substation, power would be transmitted to Victorville, Calif., using 162 miles of existing lines.

Garkane Power Assoc., Inc. is making a study of a powerline location to supply electrical power to the processing plant complex and the Alton coal field. The proposed 138 kV line would originate at a power source about 12 miles north of Panguitch, Utah, near US 89 and run south to the Alton area. There has been no detailed survey made of this alinement. Environmental impacts will be assessed when rights-of-way applications are filed and before approval to construct is given.

F. RELATED NON-COAL DEVELOPMENT

There may be competition between coal mining and uranium mining in the northeastern portion of the region for skilled miners and housing.

G. BASIC ASSUMPTIONS

The following narrative and table I-4 is based on projected coal and ancillary developments for the southern Utah coal region to establish parameters for analysis of cumulative regional impacts. The

Table I-4.--Basic analysis data and assumptions

Facility type	Number proposed	Water requirement (acre-ft/yr)	Miles	Acreage requirements: Included in project	Acreage requirements: Disturbed
Mines:					
Underground--	[1]2	80	----	55	55
Strip--------	[2]1	1,416	----	8,300	8,300
Powerlines[3]--	----	-----	70	140	140
Roads[3]------------		-----	100	600	[4]600
Allen-Warner Valley power system:					
Water project	1	-----	----	2,993	[4]1,187
Powerplant---	2	37,500	----	10,182	5,475
Slurry lines-	2	8,284	183	2,200	1,100
Coal processing plant	1	-----	----	1,826	1,826
Added community	----	1,660	----	362	[4]362

[1]Kaiparowits No. 5 mine (1 mty) and Blue mine (0.5 mty).
[2]Alton mines (10.5 mty).
[3]Preliminary proposals ancillary to mine plans.
[4]Probably unreclaimed.

information provides a base for future revisions of impacts based on actual development that takes place and can be utilized to determine whether the actual cumulative impact is increased or decreased.

1. Annual water use will be at the rate of one acre-foot (326,000 gallons) for four people; for each acre foot used, one-half acre-foot will be returned to the system for down stream use.[1]

2. Sewage treatment plants are or will be made adequate such that raw sewage will not be discharged.

3. Sewage effluent will not be recycled for domestic use.

4. Community development will be at the rate of 18 people per acre.

5. Lands converted to housing will not be returned to agriculture in the future.

6. Mining will be conducted so as to yield maximum recovery of the coal deposits consistent with protection and use of other natural resources, sound economic practice and protection of the environment.[2]

7. Mine production will average 15 tons per manshift for underground mining[3] and 75 tons per manshift for surface mining.[4]

8. Longwall mining methods will be used where technically and economically feasible.

9. The demand for coal will increase at a rate that will continue to encourage development of Utah coal.

10. Mining and reclamation technology will not change significantly over the time frame of the analysis (1990).

11. Labor and equipment shortages will not significantly distort the projected levels of development.

12. Future traffic on a given segment of highway will be predicted based on the historic relationship between population and traffic for that segment.

13. Future traffic will be accommodated on the existing and presently proposed highway system. Shortfalls in capacity will be accommodated through expansion of the specific overloaded elements of this system.

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[1]Based on available records on water use and sewage effluent.

[2]Considering current experience in Utah GS reserve calculations are based on 50 percent recovery for underground mines. Surface mining--94 percent recovery.

[3]1976 Rate in Utah averaged 12.1 tons per manshift.

[4]Based on similar western surface mines.

14. Proposed mines will not be producing before 1980 but will all be in production by 1985. Full proposed production will be reached by 1990.

15. In estimating commuting traffic, it was assumed that all employees would commute by motor vehicles, and that the vehicles would contain an average of 2.0 persons.

16. It was assumed that the average fuel efficiency of motor vehicles would improve by 75 percent between 1975 and 1990.

17. It was assumed that coal-haul trucks would have a net load capacity of 25 tons.

18. Incidental service-truck traffic to mines was estimated to be 20 visits per day per million tons per year production, and included all sizes of service vehicles. For this study, however, inciden-- tal traffic was assumed to be in the heavy truck category (six - wheels and over).

19. Where specific information was not furnished by the applicant, it was assumed that access roads would have a gravel surface, would have a 22-foot travel way with 5-foot shoulders, would have ditches on both sides, and both cut and fill slopes would be 2 to 1 where this configuration could be achieved. Public roads were assumed to have a 24-foot traveled way as a minimum. The basic public road configuration was assumed to be ungraded as needed to handle anticipated traffic, as described in the text.

20. Powerline rights-of-way were assumed to be 50 feet wide for transmission lines of 69 kV or less, 120 feet for 138 kV and above, where specific information was not furnished. Clearing was to be minimum necessary.

CHAPTER II: DESCRIPTION OF THE EXISTING ENVIRONMENT

A. NATURAL ENVIRONMENT

1. CLIMATE

The climate is varied and strongly influenced by topography. The lower elevations, east of the Wasatch Plateau, are dry and are either middle latitude steppe or desert. The low amounts of annual precipitation are generally caused by the Sierra Nevada and Cascade Ranges, which rob Pacific storms of their moisture before they reach the study area. However, some of the higher terrain of the western part is able to cause enough upslope flow to have over 40 inches per year of precipitation with areas in the lee of this terrain receiving less than 8 inches. Figure II-1 presents isopleths of mean annual precipitation.

Temperature is spatially and seasonable variable in southern Utah. Figures II-2 and II-3 present mean minimum January and maximum July isotherms. Higher elevation valleys experience the coldest temperatures, whereas lowlands east of the mountains experience the highest temperatures.

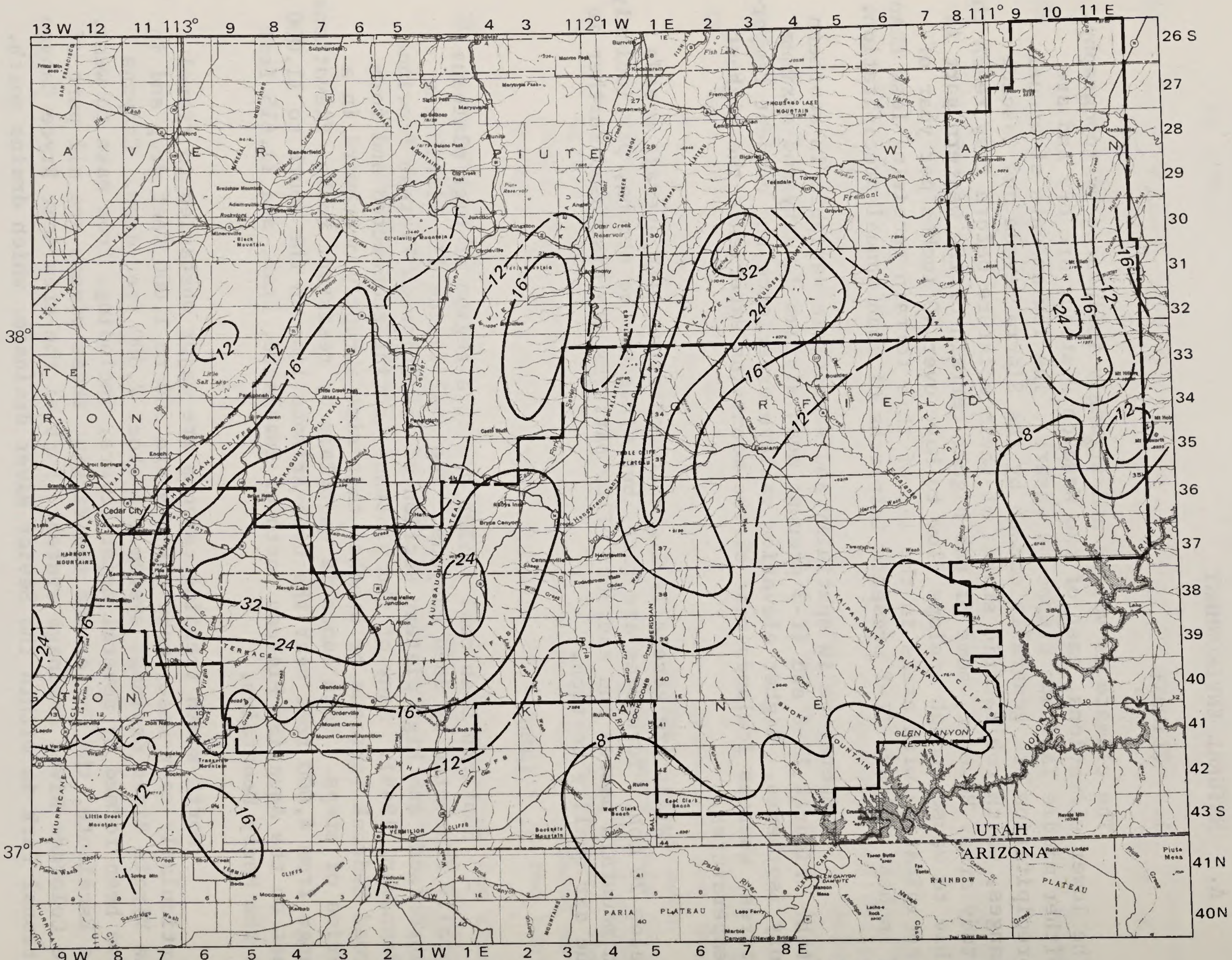
Winds are generally light to moderate, with average speeds below 20 mph. Tornadoes are rare, but winds may be strong, particularly in mountain passes and canyons. Flow patterns are discussed further in the air quality section.

2. LAND

Southern Utah coal fields are in a region of high plateaus locally dissected by deep canyons. The coal fields lie within the canyonlands and high plateau section of the Colorado Plateau Province (Fenneman, 1946). Many of the plateaus are interconnected and form broad bedrock terraces or benches that rise abruptly northward in a series of steps. Each bench is underlain by resistant rocks. Elevations range from 4,000 feet near the Utah-Arizona line on the south to 11,000 feet on the Aquarius Plateau north of Escalante, Utah, and 11,615 feet in the Henry Mountains.

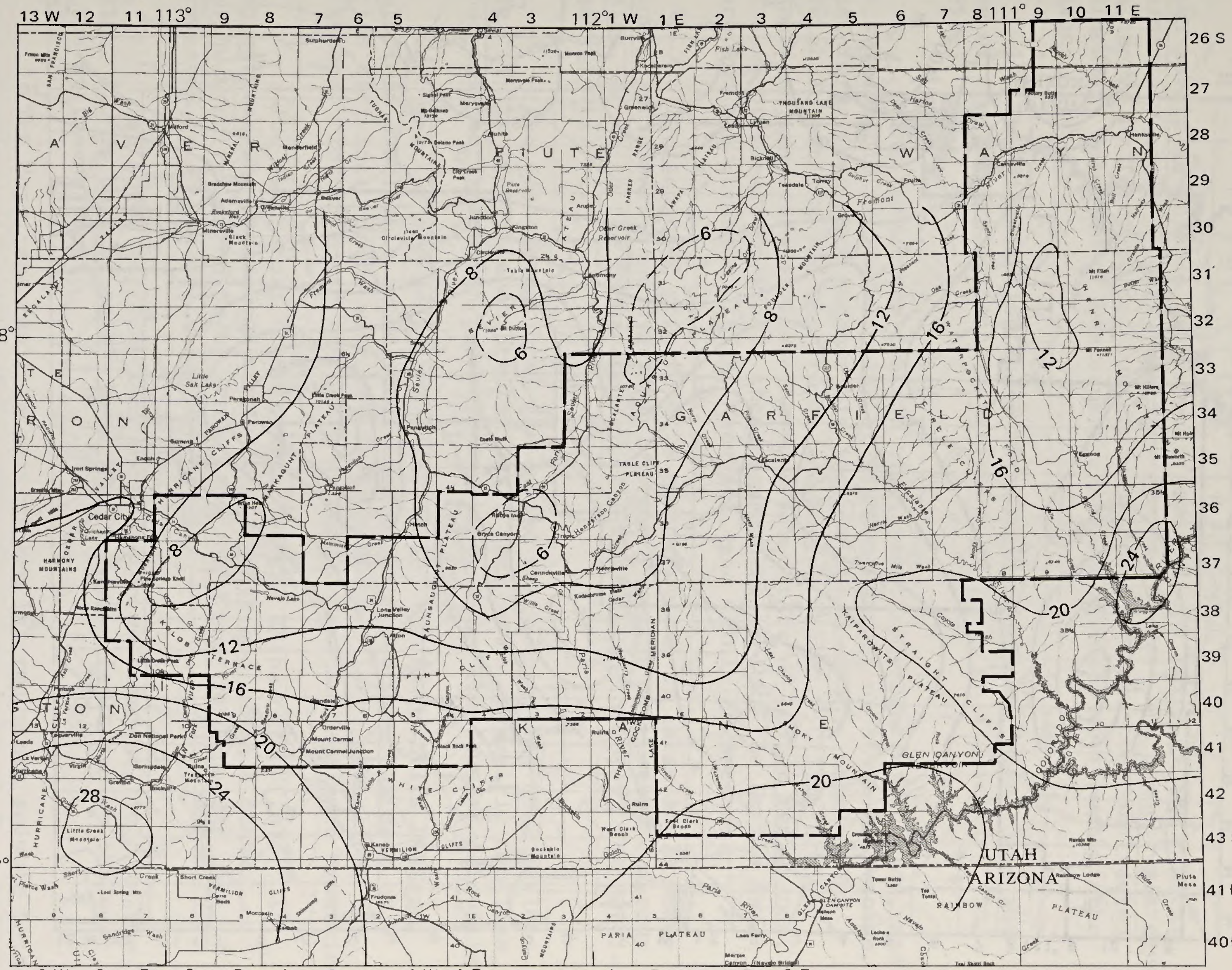
North-south trending canyons are major obstacles to travel particularly east-west; many canyons are 500 to 1,000 feet deep and in the Virgin River drainage system are about 2,000 feet deep. Canyons have been formed by several major rivers, including, from east to west, the Escalante, the Paria, and the Virgin; these rivers are all part of the Colorado River drainage system. Part of the area near Bryce Canyon National Park is within the Sevier River drainage, which drains north.

The geology of the region has been summarized by Sargent and Hansen (1976), Doelling (1972), and Hunt and others (1953). Most exposed rocks are of Mesozoic age. In some areas, such as the Circle Cliffs,



Base from U.S. Geological Survey
Arizona, 1974, and Utah, 1969
State base maps 1:500,000

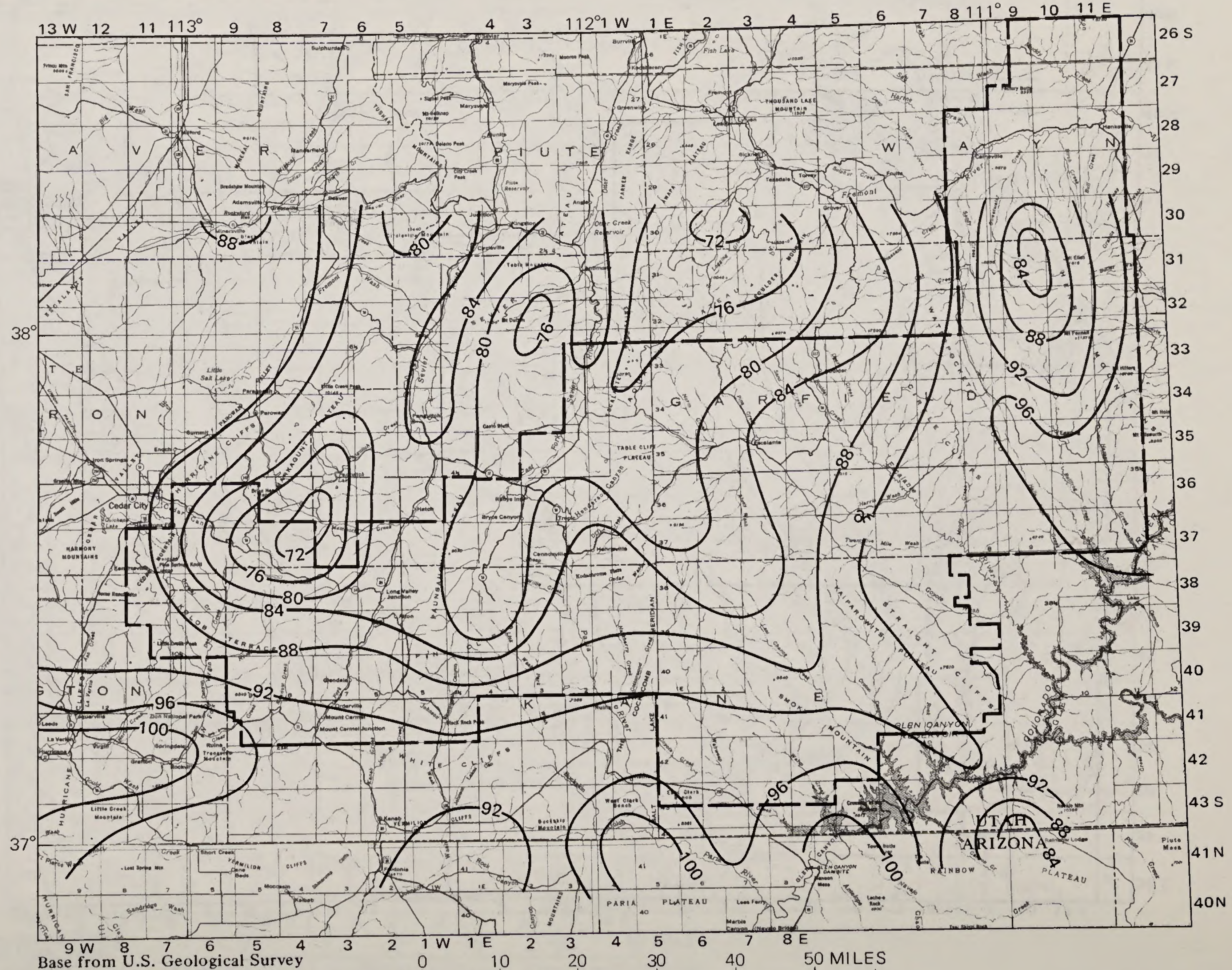
Figure II-1.--Mean annual precipitation.



Base from U.S. Geological Survey
Arizona, 1974, and Utah, 1969
State base maps 1:500,000

0 10 20 30 40 50 MILES

Figure II-2.--Mean minimum temperatures.



Base from U.S. Geological Survey
Arizona, 1974, and Utah, 1969
State base maps 1:500,000

Figure II-3.--Mean maximum temperatures.

rocks as old as Permian are exposed; and in some parts of the region, sedimentary rocks of early Tertiary age are found. The highest plateaus are capped by Tertiary and Quaternary volcanic rocks. Unconsolidated sedimentary deposits of Quaternary age form a veneer over much of the region.

The distribution and a brief description of these rocks and some of their hydrologic characteristics is given on figure II-4 (in pocket).

Many formations contain clay, especially bentonitic clay, and are susceptible to landslipping or slumping during or after excavation. Those formations most susceptible include the Moenkopi, Chinle, and Wasatch Formations and the Tropic and Mancos Shales. Cliff-forming formations, especially where they overlie strata of lesser resistance, are susceptible to rockfall; these formations include the Navajo Sandstone and the Straight Cliffs, Moenkopi, and Chinle Formations.

The geologic structure is characterized by large-scale monoclines, anticlines, and synclines. These features are cut by numerous faults, of which the major ones are the Paunsaugunt, Sevier, and Hurricane (fig. II-4).

The easternmost coal field, the Henry Mountains coal field (fig. II-5), lies in a structural basin that is an asymmetric syncline, whose axis strikes north and passes near or under the town of Cainville.

West of the Henry Mountains field, the Kaiparowits Plateau coal field overlies a broad structural basin bounded on the east by a series of folds; on the west, it is bounded by a large monocline, the Cockscomb. To the north the basin extends under the Escalante Mountains.

The Alton coal field is west of the Kaiparowits field. It lies between the Paunsaugunt and Sevier faults and is on a broad, shallow syncline. The north end of the field and the syncline are terminated by an east-west trending fault.

The Kolob Terrace coal field is the westernmost field in the region. It is bounded on the east by the Sevier fault and on the west by the Hurricane fault.

The Hurricane fault is part of the Intermountain seismic belt, a zone of pronounced earthquake activity that extends north from Arizona and terminates in northwestern Montana. In Utah, this zone forms the boundary between the Basin and Range physiographic province (Fenneman, 1946) and the Colorado Plateaus province.

Tabulated seismic data for Utah from 1850 through June 1965 by Cook and Smith (1967) indicate that Richter magnitudes along the faults in the coal region have not exceeded 4.9, and most are less than 4.0.

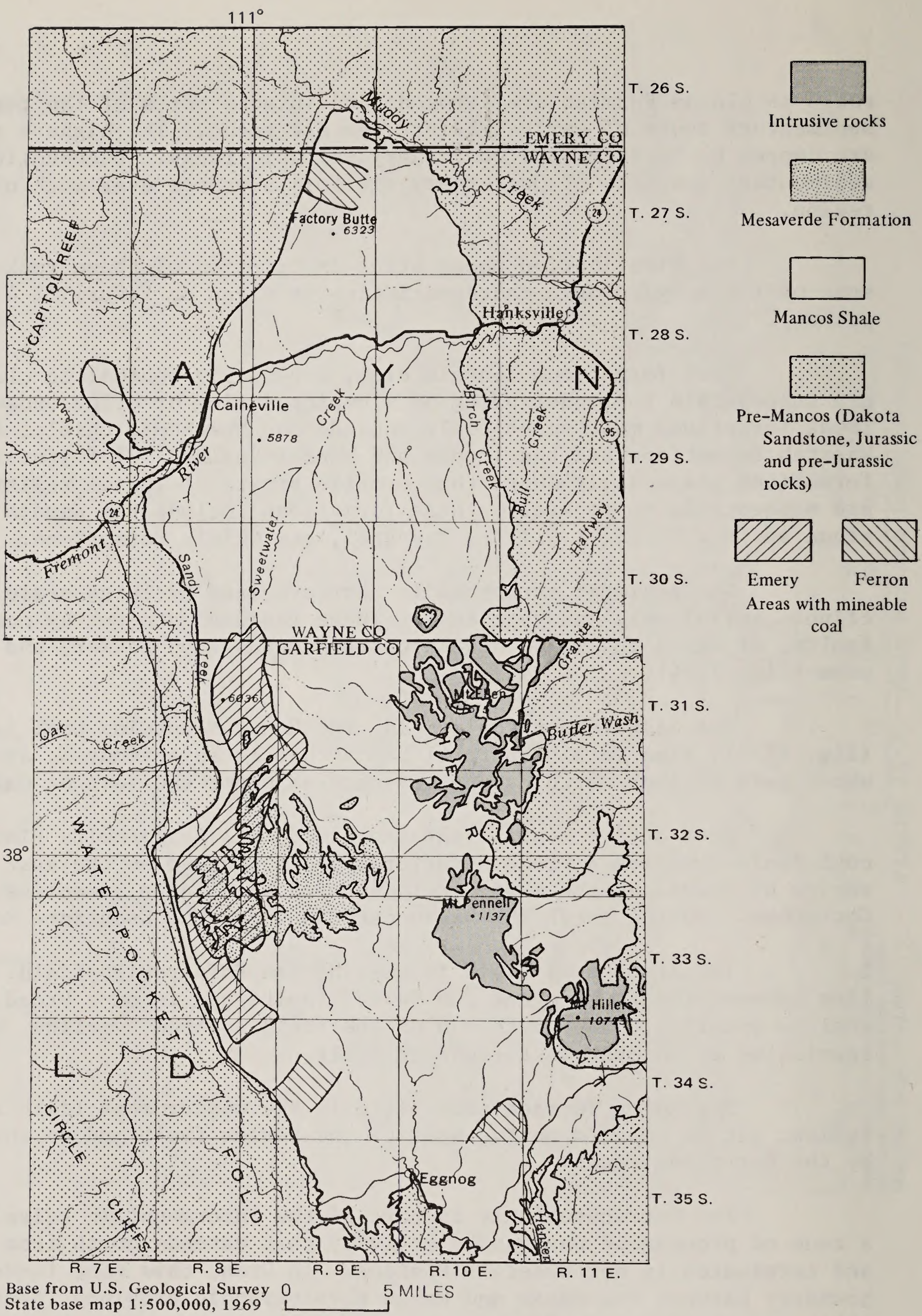


Figure II-5.--Generalized geologic-hydrologic map of the Henry Mountains.

USGS seismic records confirm continuation of mild activity to the present. The entire area has been classified by seismologists as a region of lesser seismicity (Rocky Mountain Association of Geologists, 1972). Relevant data indicate that the area is still seismically active and that earthquakes of low intensity will still occur; however, the effects of such activity can be predicted to be slight (BLM, 1975, p. II-88-90).

There are no comprehensive lists of fossils from the southern Utah coal region. Vertebrate fossils have been described by several scientists, among whom are: Dr. James H. Madsen, Utah State Paleontologist; Dr. W. I. Stokes, University of Utah; Drs. Wade Miller and James Jensen, Brigham Young University; and others. Invertebrate fossils and plant fossils have also been described from the region. Descriptions of these fossils are scattered throughout the geologic and paleontologic literature.

A study of paleontologic resources was made by the Museum of Northern Arizona in 1974 for the Kaiparowits Environmental Impact Statement (BLM, 1976, p. A609-633). Dinosaur bones, fragments of turtle shells, reptile teeth, crocodile remains, fish scales, snails and fossil wood and leaves were noted in the Kaiparowits Formation and Wahweap sandstone. Lists of fossils observed by the Museum team, and other lists taken from previously published sources, are contained in the Kaiparowits statement.

The region contains large amounts of bituminous and subbituminous coal in rocks of Cretaceous age. Coal resources by area in the Kolob, Alton, Kaiparowits and Henry Mountains coal fields are shown on figure II-6 (in pocket).

The Henry Mountains Coal Field, in Emery, Wayne, and Garfield Counties, has been described by Doelling and Graham (1972). Coal in this field is found in the Ferron and Emery Sandstone Members of the Mancos Shale and in the Dakota Sandstone. The coal in the Dakota is not of minable thickness. Coal in the Ferron is between 4 and 7 feet thick in three widely separated areas. Coal in the Emery ranges between 2 and 6 feet thick, with a reported maximum thickness of 13 feet (Peterson and Ryder, 1975). The areas that contain minable coal in the Emery are shown in figure II-5. Coal analyses from Emery and Ferron coals are given on table II-1. Coal quality ranges from subbituminous C to high-volatile B bituminous. Reserves are poorly known, but Doelling (1972) has estimated reserves to a depth of 1,000 feet, and these estimates are given in table II-2.

The Kaiparowits Plateau Coal Field, described by Doelling and Graham (1972), is located on the Kaiparowits Plateau in Garfield and Kane Counties. The minable coal beds are found in the John Henry member of the Straight Cliffs Formation (fig. II-7).

Table II-1.--Southern Utah coal quality data
[From Doelling and Graham, 1972]

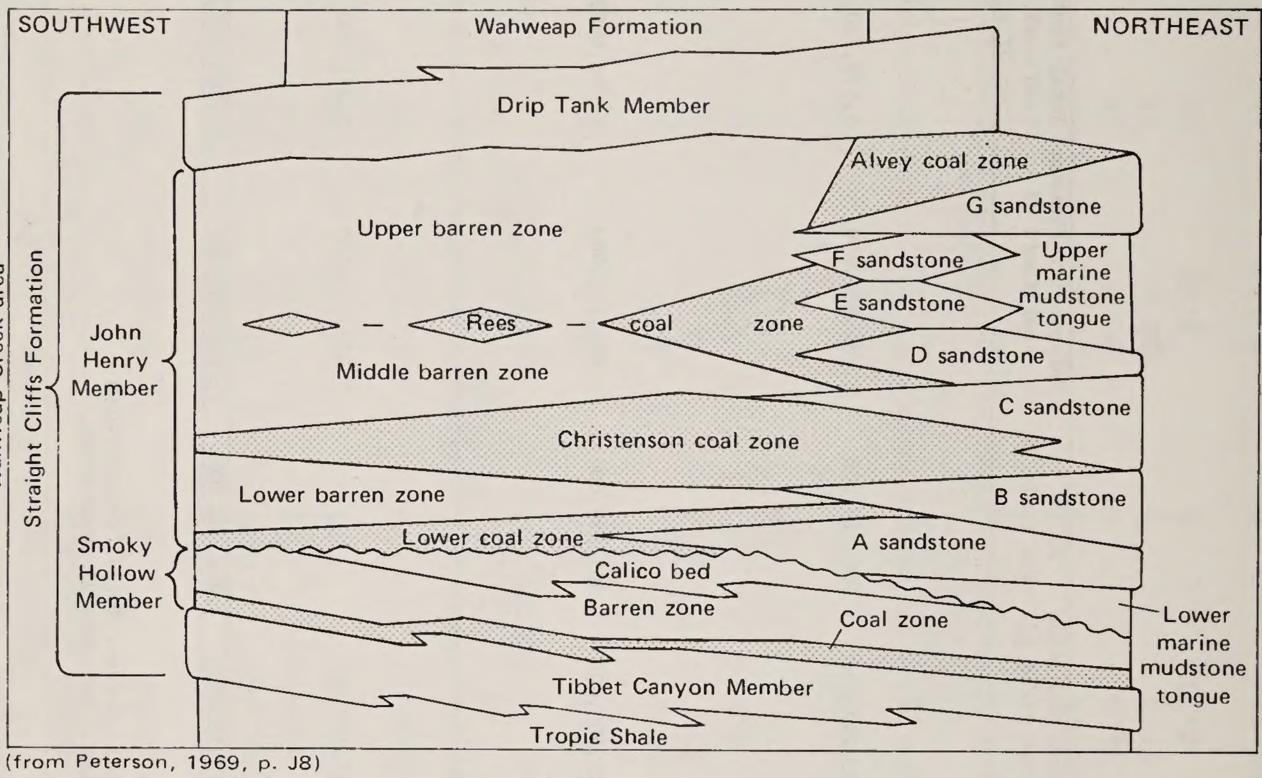
	Average percent	Number of analyses	Average percent	Number of analyses	Average percent	Number of analyses	Average percent	Number of analyses
	Kaiparowits Plateau field							
	All areas		Smoky Mountain		Escalante		Tropic	
Moisture-----	11.33	[1]137	9.63	[1]77	10.51	[1]40	19.50	[1]20
Volatile matter-----	43.63	[2]164	42.44	[2]91	45.39	[2]53	44.42	[2]20
Fixed carbon-	47.25	[2]164	48.70	[2]91	46.81	[2]53	41.81	[2]20
Ash----------	8.96	[2]165	8.59	[2]91	7.80	[2]54	13.77	[2]20
Sulfur-------	.87	[2]129	.75	[2]91	1.26	[2]24	.98	[2]14
Btu/lb-------	11,999	[2]161	12,401	[2]91	11,563	[2]53	11,207	[2]17
	Alton field							
	All areas		Alton		Skutumpah		Cannonville	
Moisture-----	17.4	[1]29	17.0	[1]13	19.3	[1]11	15.8	[1]4
Volatile matter-----	41.2	[2]27	40.1	[2]12	43.6	[2]11	37.9	[2]4
Fixed carbon-	47.5	[2]27	50.3	[2]12	46.7	[2]11	41.6	[2]4
Ash----------	11.1	[2]28	9.4	[2]13	9.8	[2]11	20.5	[2]4
Sulfur-------	1.15	[2]28	1.3	[2]13	1.07	[2]11	1.87	[2]4
Btu/lb-------	10,371	[2]27	12,069	[2]12	10,166	[2]11	8,530	[2]4
	Kolob field						Henry Mountains field	
	Cedar City		Orderville		Harmony		Henry Mountains	
Moisture-----	8.2	86	12.1	9	6.7	11	9.8	13
Volatile matter-----	39.8	86	40.1	9	10.4	11	36.5	13
Fixed carbon-	42.3	86	36.0	9	56.0	11	43.9	13
Ash----------	10.8	87	11.5	9	26.6	11	9.4	13
Sulfur-------	5.76	67	2.21	9	3.31	11	.87	13
Btu/lb-------	10,492	64	10,344	9	9,123	11	11,253	13

[1]As received.
[2]Dry.

Table II-2. Coal reserves (in short tons)

Reserve Classification 1/	Classification Criteria 1/	Alton coal field 2/	Henry Mountains coal field 2/	Kolob coal field 2/	Kaiparowits Plateau coal field 2/	Total Southern Utah coal region (sum of columns)	Kaiparowits Plateau coal field 3/
Measured reserves (Class I)	Based on adequate exploration and development data, properly correlated.						
Indicated reserves (Class II)	Based on geologic measurement supplemented by limited drill-hole data and limited to 1 1/2 miles from a control point.	643,800,000 4/	202,400,000 4/	708,710,000 4/	3,784,800,000 4/	5,539,710,000 4/	20,600,000,000
Inferred reserves (Class III)	Based on geologic inferrence and projection of the habit of the coal beyond 1 1/2 mi. from control points.	865,600,000	28,600,000	1,305,590,000	3,893,200,000	6,092,990,000	
Potential reserves (Class IV)	Based on geographic and geologic position, with little supporting data, and includes coal concealed by 3,000 feet or less of cover.	637,500,000	311,500,000	—	7,320,000,000	8,271,000,000	
Total		2,148,900,000	542,500,000	2,014,300,000	15,198,000,000	19,903,700,000	

1/ After Doelling, 1972_.
2/ Adapted from Doelling, 1972_, table 4, p. 550-551.
3/ Unpublished preliminary data, Conservation Division, U. S. Geol. Survey. Total "demonstrated coal resource", in beds 4 feet or more thick, beneath less than 3,000 feet of overburden.
4/ Includes a small amount of Class I reserves.



(from Peterson, 1969, p. J8)

Figure II-7.--Relations of members and informal units in the Straight Cliffs Formation.

The best quality coal in the region is found in the Kaiparowits Plateau field (table II-1). The higher quality coals from Christensen and Alvey zones account for most of the reserves; however, those from the Reese zone are also significant. Most of the known reserves are from the Smoky Mountain and Escalante area; those from the northern part of the field are not well known.

About 220,800 acres of land in and adjacent to the Kaiparowits Plateau is currently under coal lease, prospecting permit, or competitive lease applications. There are 12 holders of leases and prospecting permits in the Kaiparowits area. In addition, more than 40,000 acres is under State lease. Major lessors and permittees are Resources Company, El Paso Natural Gas, Consolidation Coal Company, Peabody Coal Company, Sun Oil Company, Del Coal Incorporated, Woods Petroleum, J. H. Knight, and Hiko Bell Mining and Oil. Total reserves of coal are estimated to be 15 billion short tons (Doelling and Graham, 1972).

The Alton Coal Field, described by Doelling and Graham (1972), lies west of the Kaiparowits Plateau field in Kane and southern Garfield Counties. Much of the coal in this field is strippable. The minable coal is in the Dakota sandstone. The quality (table II-1) ranges from subbituminous C to bituminous high-volatile C. Reserves in the Alton field are given on table II-2.

The Kolob Terrace Coal Field, described by Doelling and Graham (1972), lies west of the Alton field in Washington, Kane, and Iron Counties. Coal is contained in several zones in the Tropic Shale-Dakota Sandstone interval and in the Straight Cliffs Formation (Sargent and Hansen, 1976). The coal from this field ranges from high-volatile bituminous C to subbituminous A; the quality is summarized on table II-1.

Methane and other noxious or combustible gases are present locally, in unknown concentrations, in some coal beds and overburden rocks of the region.

Other mineral resources in the region have been summarized by Sargent and Hansen (1976) and Hunt and others (1953).

A few test wells for oil and gas have been drilled, and a small oil field, the Upper Valley field, was developed in 1964. This field, about 10 miles southwest of Escalante, had produced about 15 million barrels of oil through December, 1975. Doelling (1975) has estimated as much as 30 million barrels of ultimate recovery. Tar sands are found in the Circle Cliffs and are known to contain several hundred million barrels of bitumen (Doelling, 1975).

Known uranium deposits are small and of low grade. Those that could be of future economic value are found in the Circle Cliffs and Waterpocket Fold (Capitol Reef) areas. Copper is found in the Circle

Cliffs area (Davidson, 1967), in the Capitol Reef area, and locally in the Paria River basin. Other metallic mineral deposits have been found in small uneconomic amounts.

Clay, gypsum, sand and gravel, and dimension stone are present throughout the region in large amounts. Limestone suitable for rock-dusting in coal mines and stack-scrubbing of SO_2 in coalfired powerplants is present in the Wasatch Formation on the west side of Johns Valley. Other nonmetallic resources, such as silica sand, diatomite, and volcanic ash are present; gem materials, mainly jasper, agate, petrified wood, and dinosaur bone are found at scattered localities.

Soils vary considerably in response to changes in geology, topography, climatic conditions, and vegetation. They have formed primarily from sandstone and shale which yield sandy to clayey textures. The clayey soils are especially prone to erosion by water, whereas wind erosion is most active on the sandy soils. Soils over most of the area receive sparse amounts of precipitation, which results in limited soil development and low productive potentials. Roughly 25 percent of the area consists of rockland and badlands with essentially no soils.

The soils in zones of less than 15 inches of annual precipitation are typically high in soluble salt content, have a high pH, are low in organic matter, and typically have an accumulation of carbonate in the subsoil which often forms a hardpan. Vegetation is generally sparse, leaving much of the soil exposed to the erosive forces of wind and water. As elevation and precipitation increase, the soils tend to have better development and increase in productive potential until the cold, often rocky sites at high elevations are reached.

The soils represent 10 groups composed of 27 different soil associations, as identified by Wilson and others in Soils of Utah (1975). Distribution and extent of the various soils are shown on figure II-8.

Table II-3 gives a brief description of the landforms, climate, and use of the soil groups. The soil characteristics and taxonomic classifications are given in table II-4. These descriptions are for relatively broad units of land, and there are local variations within each soil area. The major limiting factors listed occur within the soil associations but may not occur throughout the entire association.

3. WATER

a. Water Supply

The Colorado River system is the main water source in the region but the quantity of water that can be used in Utah is limited by the Upper Colorado River Basin Compact of 1948. Under that compact, Utah's allotment of water from the Upper Colorado River Basin is about

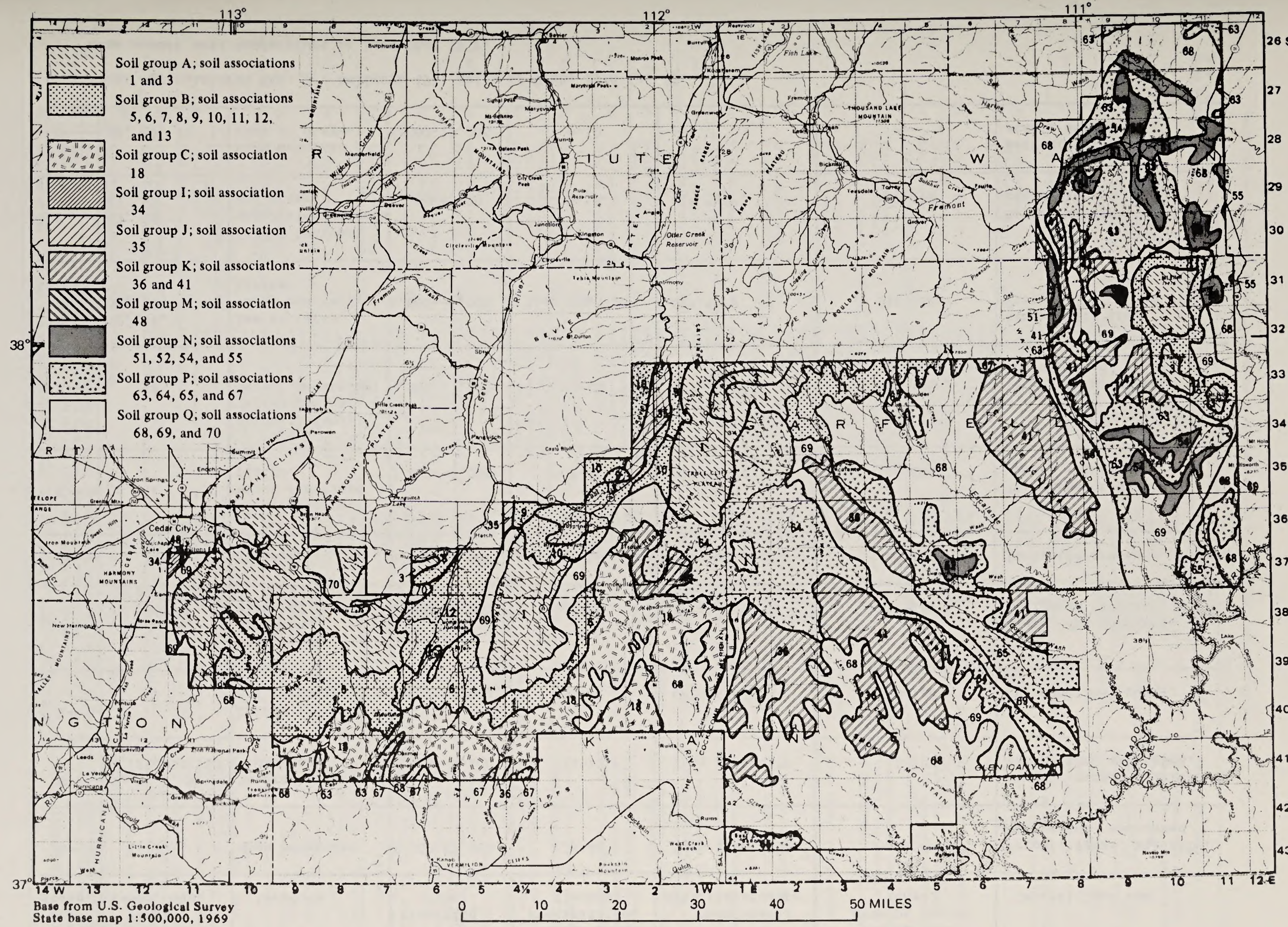


Figure II-8.--Map of soil groups and associations

Table II-3.--Landform, climate and land use of the soil groups and associations[1]

Soil group	Soil assoc. nos.	Landform	Elevation (feet)	Average annual precipitation (inches)	Mean annual soil temperature	Freeze free growing season (days)	General land use
A----	1, 3	High mountains.	8,000-12,000	18-40	Less than 47°F.[2]	0-60	Forest, range, wildlife, recreation, watershed.
B----	5, 6, 8, 9, 10, 11, 12, 13	Mountains and plateaus.	6,000--8,400	14-22	Less than 47°F.	60-100	Forest, range, wildlife, recreation, watershed.
E----	18	Upland plains and terraces.	5,500--7,000	12-14	47°-59°F.	110-180	Dry cropland, range.
I----	34	Foothills, terraces, alluvial fans.	4,300--6,000	12-14	47°-59°F.	110-180	Range, dry cropland, irrigated cropland.
J----	35	Valleys.	6,000--7,000	8-14	Less than 47°F.	80-110	Irrigated cropland, range.
K----	36, 41	Alluvial fans, mesas and flood plains.	3,600--7,000	8-14	47°-59°F.	110-180	Irrigated cropland, range, wildlife.
M----	48	Alluvial fans, valley plains, desert mountains.	4,300--7,500	8-14	47°-59°F.	110-180	Irrigated cropland, dry cropland.
N----	51, 52, 54, 55	Low terraces, fans, and valley plains.	4,000--6,000	Less than 10	47°-59°F.	110-180	Range, wildlife, irrigated cropland.
P----	63, 64 65, 67	Valley bottoms, undulating uplands and mesas.	4,200-6,600	6-18	41°-55°F.	100-190	Range, wildlife, recreation.
Q----	68, 69, 70	High mountain tops to playas.	3,000-13,000	6-40	---	---	Recreation, watershed, scenic areas.

[1]From: Agriculatural Exp. St. Bulletin 492, Soils of Utah, 1975 (p. 3).

[2]Mean summer soil temperature is less than 59°F.

Table II-4.--Characteristics and classification of soil associations in the Southern Utah coal region

Soil group	Soil assoc.	Taxonomic classification	Soil depth	Soil textures	Soil reaction	Drainage class	Permeability	Major limiting factors
A---	1	Argic Cryoborolls- Pachic Cryoborolls- Cryic Paleborolls	20-36"	Silt loam to clay loam over cobbly loam to clay loam.	Slightly alkaline to strongly acid.	Moderately well to excessively drained.	Slow to rapid.	Steep slopes, some areas with unstable soils, high elevations, some rocky areas.
	3	Lithic Cryoborolls- Mollic Cryoboralfs- Rock Outcrop	10-36"	Loam to cobbly loam over cobbly loam to cobbly clay loam.	Mildly acid to strongly acid.	Well to excessively drained.	Slow to moderate.	Steep slopes, high elevations, shallow soils, cobbly soils, some rocky areas.
B---	5	Typic Argiborolls- Lithic Argiborolls- Typic Haploborolls	10-36"	Cravelly loam to silty clay loam over cobbly loam to cobbly clay loam.	Neutral to moderately alkaline.	Well drained.	Slow to moderate.	Steep slopes, shallow soils, some areas with unstable soils, somewhat limited precipitation (14-20").
	6	Typic Argiborolls- Typic Ustorthents	10-36"+	Gravelly loam to silty clay loam over silty clay loam to clay.	Neutral to moderately alkaline.	Well to moderately well drained.	Slow to very slow.	Clayey soils, some steep slopes, somewhat limited precipitation (14-20").
	8	Lithic Argiborolls- Typic Argiborolls	10-36"+	Loam, gravely loam, and cobbly to very gravelly loam and fine sandy loam over cobbly to very gravelly loam-clay loam.	Neutral to moderately alkaline.	Well drained.	Slow to moderately slow.	Steepness of slopes, some shallow soils.
	9	Lithic Argiborolls- Rock Outcrop- Typic Argiborolls	10-36"	Gravelly to cobbly loam over cobbly to gravelly loam and clay loam.	Neutral to moderately alkaline.	Well drained.	Moderate to slow.	Steep slopes, shallow soils, cobbly soils, somewhat limited precipitation (14-20").
	10	Typic Haploborolls- Typic Argiborolls- Typic Calciborolls	20-36"	Cravelly loam, silt loam, or sandy loam over gravelly to cobbly sandy loam and clay loam.	Neutral to moderately alkaline.	Well drained.	Moderate to rapid.	Somewhat limited precipitation (14-20"). Calcium carbonate layers in the subsoil.
	11	Lithic Haploborolls- Lithic Argiborolls- Typic Haploborolls	10-36"+	Gravelly and cobbly loam to sandy loam over gravelly to cobbly loam to clay loam.	Neutral to moderately alkaline.	Well to somewhat excessively drained.	Slow to moderately rapid.	Steep slopes, shallow soils.
	12	Lithic Haploborolls- Lithic Calciborolls	10-20"	Cravelly and cobbly loam to sandy loam over very gravelly to cobbly loam.	Neutral to moderately alkaline.	Well to somewhat excessively drained.	Moderate	Shallow depth to bedrock, steep slopes.
	13	Typic Ustochrepts- Cumulic Haploborolls	10-36"+	Cravelly loam, clay loam, and silt loam over gravelly loam, clay loam or silty clay loam.	Neutral to moderately alkaline.	Well drained.	Moderate to moderately slow.	Wind and water erosion potential, some steep slopes.
E---	18	Aridic Argiustolls- Typic Argiustolls	20-36"+	Loam to very fine sandy loam over silty clay loam.	Neutral to moderately alkaline.	Well drained.	Moderate	Low precipitation (12-14"), wind erosion potential.
I---	34	Aridic Calcixerolls- Xerollic Calciorthids	36"+	Loam, cobbly loam and gravelly loam over very gravelly to cobbly loam.	Moderately to strongly alkaline.	Well to somewhat excessively drained.	Moderate to rapid.	Low precipitation (12-14"), calcium carbonate hardpan within 20" of the surface.
J---	35	Ustollic Torrifluvents Borollic Calciorthids	36"+	Loam to gravelly loam over clay loam to gravelly loam.	Mildly to strongly alkaline.	Well drained.	Moderate to moderately rapid	Limited precipitation (8-14"), calcium carbonate layers in the subsoil, some clayey subsoils.
K---	36	Ustic Torrifluvents- Ustic Torriorthents	36"+	Fine sandy loam to silty clay loam over sandy loam to silty clay.	Mildly to moderately alkaline.	Well to moderately well drained.	Slow to moderately rapid.	Limited precipitation (8-14"), erosion potential by wind and water.
	41	Lithic Ustollic Calciorthids- Lithic Ustic Torriorthents	10-36"	Cobbly fine sandy loam to loam over clay loam to very cobbly sandy loam.	Mildly to strongly alkaline.	Well drained.	Moderate to rapid.	Limited precipitation (8-14"), some steep slopes, shallow soils, rock outcrops, cobbly surface soils.
M---	48	Xeric Torrifluvents- Xerollic Calciorthids	36+	Silt loam, loam, and fine sandy loam over silty loam to sandy loam and gravelly loam.	Mildly to strongly alkaline.	Well drained.	Moderately slow to moderately rapid.	limited precipitation (8-14"), calcium carbonate layers are present at 12-24' in some of the soils.
	51	Aquic Xerofluvents- Aquic Ustifluvents- Typic Torrifluvents	36"+	Fine sandy loam to clay over sandy loam to clay.	Mildly to strongly alkaline.	Well to somewhat poorly drained.	Slow to moderately rapid.	Bank cutting, low precipitation (less than 10"). Water table at 20-40" on some of the soils. Clayey soils.
	52	Typic Torrifluvents- Typic Torriorthents	36"+	Silty clay loam, loamy fine sand or sandy clay loam over silty clay loam to sand.	Mildly to strongly alkaline.	Moderately well to somewhat exc. drained.	Slow to rapid.	High salt contents, low precipitation (less than 10"), high temperatures, clayey soils.
	54	Lithic Calciorthids- Typic Calciorthids	10-36"+	Fine sand to very fine sandy loam over gravelly sands to clay loam.	Moderately to very strongly alkaline.	Well drained.	Moderate to rapid.	Low precipitation (less than 10") strongly alkaline soils, some shallow soils over bedrock, calcium carbonate layers.
	55	Typic Calciorthids- Typic Torriorthents	36"+	Cravelly sandy loam to sandy clay loam over clay loam to gravelly sandy loam.	Moderately to strongly alkaline.	Well to somewhat excessively drained.	Slow to rapid.	Low precipitation (less than 10"), calcium carbonate layers are present in some of the subsoils.
	63	Typic Torriorthents (shallow)- Lithic Caliorthids- Lithic Natrargids	10-36"	Silt loam to silty clay loam over clay loam to loam.	Mildly to verystrongly alkaline.	Well drained.	Moderate to slow.	Clayey soils, alkalinity, limited precipitation (6-18'), some shallow soils.
	64	Ustic Toriorthents (shallow)- Rock Outcrop	10-20"	Loam to silty clay loam over loam to silty clay.	Mildly to moderately alkaline.	Well drained.	Moderate to very slow.	Rock outcrops are common, clayey soils, limited precipitation (6-18").
P---	65	Typic Torripsamments- Typic Torriorthents	36"+	Fine sand to loamy fine sand.	Mildly to strongly alkaline.	Somewhat excessively drained.	Rapid	Fine sandy soils, wind erosion potential, limited precipitation calcium carbonate layers some soil
	67	Ustic Torripsamments	36"+	Fine sand,	Mildly alkaline.	Somewhat excessively drained.	Rapid	Fine sandy soils, wind erosion potential.
	68	Rockland		This is a miscellaneous land type. More than 50 percent of the area is rock outcrop.				Rocky land, steep slopes, limited precipitation (6-18").
Q---	69	Badland- Rockland		This is a miscellaneous land type. The area is mainly barren shale and sandstone. Much of the area is very steep and highly dissected.				Steep slopes, rocky land, clayey soils, high soil erosion, low precipitation, high salt contents.
	70	Rockland of the high mountains		This is a miscellaneous land type. It is composed of steep, rocky colluvial areas and rock outcrops in the mountains above timberline.				Very rocky land.

1,400,000 acre-feet per year. In 1975, the estimated annual use was 850,000 acre-feet and approved filings amounted to about 550,000 acre-feet per year; thus, only a small part, if any, of Utah's Colorado River water is yet "unappropriated" (Utah Division of Water Resources, 1976).

Water use in Utah, as in other western states, is based on the doctrine of prior appropriation. Under this doctrine, the State allocates unappropriated water to an individual or corporation upon his compliance with the provisions of the State law. First in time, first in right--and beneficial use is the measure and the limit of the right. This right to use has taken on the attributes of private property, and an acquired right may be sold and transferred to another party, or even under certain conditions may be moved from one place to another. Utah water laws do not recognize instream use of water for preservation of aquatic habitat as a beneficial use. Thus, a stream can be dewatered by diversion unless a downstream water right requires flows to be bypassed.

The State Engineer, who is the Director of the Division of Water Rights, is responsible for administrating all water rights within the State and for determining whether proposed applications can be approved by State statutes and law.

Estimates of the use of water in the study area are as follows:

irrigation	93-96 percent
municipal and industrial	4-6 percent
managed wetlands	0-5 percent

The quantity of water applied annually to croplands averages 3.6 acre-feet per acre.

Both ground water and surface water are used in the region. Surface water is the major source; relatively large amounts, about 25,000 acre-feet per year in the lower Fremont River Valley and 8,000-10,000 in the Escalante Basin, are diverted for irrigation and some wetlands management. Ground water is also used to some extent for irrigation, for domestic and stock purposes, and public supply. Although the total amount of ground water used is small, it is the principal source of water for the small communities (total domestic use is about 100 acre-feet per year). Water from both wells and springs is utilized, but springs provide the greater quantity of water.

Springs and seeps throughout the area are sources of drinking water for livestock and wildlife; many have not been mapped, and the number and flow of these springs probably varies with the season and climatic conditions. Some may go dry at times. The total volume of water used is not known, but is presumably small. Nonetheless, these springs and seeps are an important source of water for livestock and wildlife.

1. Surface Water

The Colorado River and Lake Powell are the major sources of surface water. The average annual discharge of the Colorado River at Lees Ferry, Ariz. was 12.96 million acre-feet for 49 years before completion of Glen Canyon Dam in 1963. The usable storage capacity of Lake Powell is about 25 million acre-feet, excluding bank storage around the lake. Most of the study area is drained by tributaries to the Colorado River and Lake Powell, but a small part (about 10 percent) along the northwest edge is drained by the headwaters of the Sevier River, which flows into the Great Basin. Most of the area receives less than 16 inches of precipitation per year, and little runs off. Streamflow is perennial in small tributaries in the mountains and in a few large streams that head in the higher mountains. Most streams, however, are ephemeral and flow only in direct response to precipitation or snowmelt. Summer precipitation does not usually produce much runoff. Intense rainfall may cause heavy flooding at times, but the areas affected are usually small; hence, total runoff is small. The 100-year 6-hour precipitation ranges from 2 inches near Lake Powell to 3 inches in the mountains. Snowmelt is a major contributor to streamflow. Snow is generally stored through most of the winter at higher altitudes and gradually melts during the spring and early summer. Ground water also contributes to streamflow; it provides the continuity of flow (base flow) in the perennial streams, as well as some seasonal flow to intermittent streams.

Available streamflow data, including maximum, minimum, and average flows, and data-collection sites, are identified on figure II-4. The flow of some of the major rivers and the principal tributaries is affected by diversion of water, mainly for irrigation, and by storage reservoirs. Only miscellaneous discharge measurements are available for the intermittent streams that drain the Kaiparowits Plateau. However, based on channel geometry characteristics the total mean annual runoff from the plateau is estimated to be 6,000 acre-feet (BLM, 1976).

2. Ground Water

Geology is the principal factor controlling the occurrence and availability of ground water. Rocks underlying the area are mainly sedimentary. Volcanic rocks underlie parts of the higher plateaus, and alluvium underlies reaches of the larger valleys. Sandstone constitutes the most extensive bedrock aquifers. Unconsolidated deposits of Quaternary age constitute the most permeable aquifers.

Water-table conditions commonly prevail in shallow alluvium along the larger streams and in relatively flat lying sedimentary rocks. Artesian conditions occur at depth in part of the area, but flowing wells occur only in a few places.

Ground water is recharged principally in the higher plateaus, which receive the most precipitation and produce most of the runoff. Ground water moves from areas of recharge to discharge areas, which include numerous widely scattered springs, gaining reaches of streams, and patches of phreatophytes. Withdrawal by wells apparently has not had widespread nor significant effects on ground-water levels. Changes in ground-water levels (which reflect changes in ground-water storage) are caused chiefly by changes in precipitation and to a lesser extent by evapotranspiration.

Yields to individual wells and springs are generally small in most places. Wells that tap sedimentary rocks generally yield less than 50 gal/min, although a few yield more than 1,000 gal/min. Yields of 50 to 500 gal/min are generally available from alluvial wells in the larger stream valleys. Springs are numerous and discharge from less than 1 gal/ min to several hundred. The geologic formations and their water-bearing properties are listed in figure II-4.

In the Escalante River Basin and adjacent smaller drainage basins in the eastern part of the region, yields are small to moderate (less than about 50 gal/min) from sandstone, limestone, and volcanic rock, and probably large (more than 100 gal/min) from massive sandstone. Many of the present supplies of water are from springs. Information on the occurrence of ground water is available from Goode (1969), U. S. Bureau of Land Management (1976), Price (1977b), and Feltis (1966).

The availability of ground water in almost all of the Escalante and adjacent basins is described on a map by Price (1977b). Most rocks yield 5 to 50 gal/min to wells, but massive sandstone along Lake Powell may yield 500 to more than 1,000 gal/min. Springs yield less than 1 to about 20 gal/min, generally, but more than 100 gal/min in some places.

Rocks in the Paria River Basin yield little or no water from thick shale and thin-bedded sandstone and limestone but moderate to possibly large amounts from thick or massive sandstone. Yields of wells in the eastern Paria River Basin vary widely, and may be as much as 500 gal/min in places (Price, 1977b, and Price and Waddell, 1973). The area has a few wells, but most of the developed water supplies are from springs. Information on the occurrence of ground water west of the Paria River is available from Marine (1963), Goode (1966), and Feltis (1966).

In the lower Colorado Basin volcanic rocks and thin-bedded and fine-grained sandstone and shale yield small amounts (less than 10 gal/min) of water to wells and springs; alluvium, interbedded limestone and sandstone, and thick sandstone yield moderate amounts (about 50 gal/min); and thick, massive sandstone yield large amounts (more than 100 gal/min).

Ground water discharges by springs from limestone of the Wasatch Formation and from sandstone beds above siltstone or claystone in the Kaiparowits and Wahweap, and Straight Cliffs Formations into upper Kanab Creek and the East Fork of the Virgin River and its tributaries.

The Navajo Sandstone and the Straight Cliffs, Wahweap, and Kaiparowits Formations constitute the principal aquifers of the Kanab Creek and upper Virgin River Basins. The Navajo is the highest yielding aquifer and may be capable of yielding more than 1,000 gal/min to wells. General information on well potential, depth to water, and change in ground-water levels, 1960-1965, in the lower Colorado Basin, is given in Brown (1976).

b. Water Quality

In general, the chemical quality of surface water is relatively good in the headwater areas but deteriorates downstream. The dissolved-solids content of surface water ranges from 100 to 500 mg/l (milligrams per liter) in headwater areas to 500 to 5,000 mg/l in the lower reaches of most streams. The dominant ions in the headwaters are calcium and bicarbonate; in the middle reaches calcium, magnesium, sodium, and bicarbonate with local variations, and in the lower reaches sodium, calcium, and sulfate (table II-5). In the lower reaches concentrations of the toxic trace elements (table II-5), cadmium (Cd), lead (Pb), manganese (Mn), and selenium (Se) frequently exceed the maximum allowable limits recommended by the EPA (1973). Streams are usually saturated with suspended sediment during snowmelt and storm runoff (USGS data, Salt Lake City, Utah and Tucson, Ariz.).

The concentration of dissolved solids in streams is usually inversely proportional to flow. Thus, the chemical quality of water is usually best during high flow and worst during low flow.

The dissolved-solids content of the Colorado River at Lees Ferry averages 500 mg/l and Lake Powell averages 500 to 815 mg/l (BLM, 1976, p. II-154). Concentrations of dissolved solids in the Colorado River at Lees Ferry ranged from 476 to 757 mg/l during the last 10 years (USGS water-data reports, 1967-1976).

The quality of most of the water from wells and springs is good (dissolved-solids concentrations are less than 1,000 mg/l), although locally some water may contain concentrations of dissolved solids ranging from 1,000 to more than 3,000 mg/l. In the Upper Colorado Region water at depths less than 1,000 feet contains concentrations of dissolved solids ranging from less than 500 mg/l of dissolved solids throughout the headwater areas of the Escalante and Fremont Rivers, along Cottonwood and Hatchberry Canyons, and in the immediate vicinity of Lake Powell. Within the Kaiparowits Plateau, the concentration of dissolved solids in ground water ranges from less than 1,000 mg/l to about 3,000 mg/l, with the greatest concentration being along the southern margin of the Plateau. The distribution of dissolved solids in ground water throughout the Upper Colorado Region is shown very generally on a map by Price and Waddell (1973). More detailed maps showing distribution of dissolved solids on a large scale are available for the Frement River Basin (Price, 1972), nearly all of the Escalante and lower Lake Powell Basins (Price, 1972, 1977a), and larger parts of the Halls Creek and Paria River Basins (Price, 1977a).

Table II-5.--Results of selected chemical analyses of water collected in 1975-1976 under the 208 Water Quality Project for the Five County Area 1/ (Constituents in milligrams per liter)

Location		Total Dissolved Solids (TDS)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Chloride (Cl)	Sulfate (SO_4)	Bicarbonate (HCO_3)	Arsenic (As)	Cadmium (Cd)	Chromium (CR)	Selenium (Se)	Zinc (Zn)
Escalante River	Min.	438	58	35	47	2.9	12	120	318	<0.001	0	0	0	0
near Escalante	Max.	960	106	71	75	7.9	31	267	492	0.058	0.004	0.004	0.20	0.060
Escalante River	Min.	307	38	14	11	2.7	8	69	153	<0.001	<0.001	<0.001	<0.001	0.020
near Lake Powell	Max.	680	116	24	40	7.3	49	270	195	0.021	0.004	0.006	0.092	0.150
Last Chance Creek	Min.	1830	178	25	283	2.3	28	1050	200	<0.001	<0.001	<0.001	<0.01	0.003
near Lake Powell	Max.	5985	484	242	1030	26.1	66	3940	232	0.055	0.160	0.030	0.353	0.048
Wahweap Creek	Min.	1580	108	51	293	7.4	80	810	71	<0.001	<0.001	<0.001	<0.01	0.010
near Lake Powell	Max.	12030	572	314	2890	19.5	612	7500	373	0.853	0.058	0.001	1.170	0.092
Paria River at	Min.	414	102	16	33	3.5	10	126	144	<0.001	0	0	0	0
U.S. Hwy. 89	Max.	4240	424	253	390	19	166	2850	283	0.029	0.002	0.008	0.170	0.087
Buckskin Gulch at U. S. Hwy. 89	Only Sample	549	12	6.2	130	11.2	4.0	160	226	0.046	0.250	<0.001	0.335	0.061
Johnson Wash at	Min.	758	35	84	66	3.2	44	230	402	<0.001	0.001	0.004	<0.001	<0.001
U. S. Hwy. 89	Max.	1350	92	116	115	15.8	62	382	548	0.012	0.002	<0.01	0.240	0.04
Kanab Creek at U.S.	Min.	240	49	21	4	0	4	48	182	0	0	0	0	0
89 north of Kanab	Max.	544	84	67	68	9.7	17	405	260	0.004	<0.001	0.003	0.008	0.05
Kanab Creek	Min.	986	96	66	42	2.1	20	302	368	<0.001	<0.001	<0.001	<0.001	
South of Kanab	Max.	1240	161	125	115	9.4	53	430	594	0.022	0.006	0.008	0.045	<0.001
E. Fork Virgin	Min.	220	45	29	0.39	0	2	20	251	0	0	0	0	0
Rvr. at Glendale	Max.	556	65	45	38	15.6	10	58	364	0.016	0.001	<0.01	<0.01	0.088
Virgin River	Min.	430	58	20	29	0.43	24	112	151	0.003	<0.001	<0.001	<0.001	0.006
near Virgin	Max.	1125	226	35	104	6.94	78	585	217	0.007	<0.001	<0.001	0.030	0.080
Virgin River at	Min.	880	90	27	138	0.15	152	227	176	<0.001	<0.001	<0.001	<0.01	0.012
U-17 nr. Harrisburg Jct.	Max.	3220	299	67	610	49.2	798	1040	276	0.090	0.001	0.01	0.132	0.189
Sevier River	Min.	112	36	14	3.0	1	1	2	187	0	0	0	0	<0.001
at Hatch	Max.	316	45	22	12.6	2.28	9.5	23	236	0.019	0.002	0.002	0.016	0.012

1/ Beaver, Garfield, Iron, Kane, and Washington Counties.

Ground water in the Lower Colorado Region varies widely in quality. Water from wells in the Navajo Sandstone generally contains less than 1,000 mg/l of dissolved solids but may contain more than 3,000 mg/l in places. Water from springs in the Navajo and Cretaceous sandstones generally contains less than 500 mg/l of dissolved solids. Water from wells and springs in other formations contains concentrations of dissolved solids ranging from less than 500 mg/l to more than 1,000 mg/l.

4. AIR

The information presented in this section is described in greater detail in the Assemblage of Data on Air Qualtity in Central and Southern Utah and Assessing the Impact of Coal Development in this Region on the Air Quality; Final Report (AeroVironment, 1977).

The terrain of the study area is both varied and rugged. Most of the region is dominated by a series of mountains and plateaus, which run generally southwest-northeast. These include the Kaiparowits, Aquarius, and Awapa Plateaus, which are crossed by many canyons and valleys.

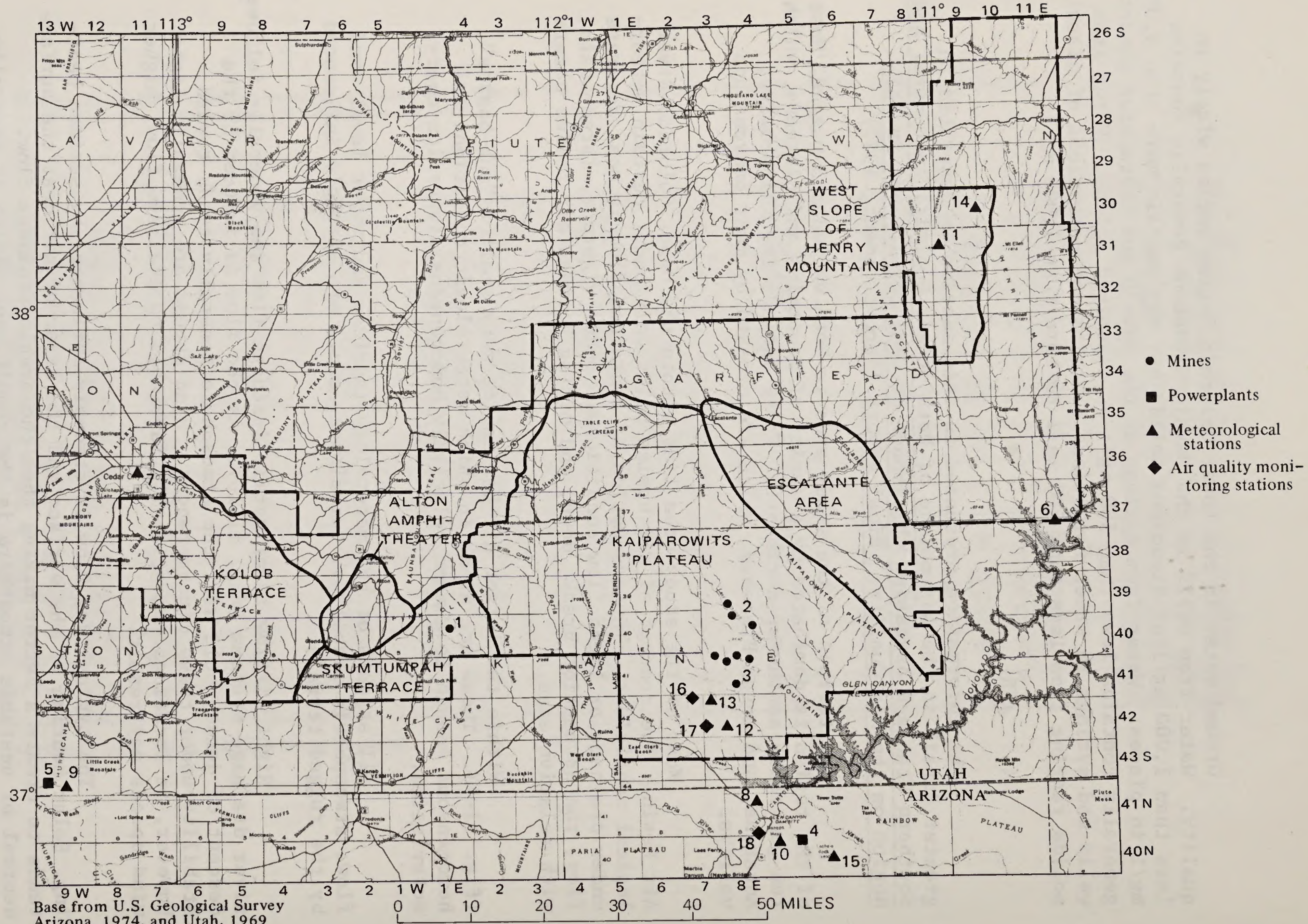
Most of the study area lies within the Upper Colorado River Air Basin. The concept of air basins holds only under certain meteorlogical conditions. The assumption of contained flow is most accurate under drainage or light flow conditions. Under vigorous, large-scale flow, the assumption breaks down, and mining between air basins occurs with relative ease.

Within the larger air basins lie many smaller "sub-basins" (fig. II-9). These are areas in which meteorologic conditions are homogeneous enough to assume relatively homogeneous dispersion characteristics.

All aspects of the meterology (surface and upper level wind flow, atmospheric stability, turbulence, etc.) are strongly influenced by the rugged terrain.

Night airflow is primarily drainage flow and generally follows river drainage systems (fig. II-10). As the flow is induced by the descent of dense, cold air, the atmosphere generally tends toward stability under these circumstances. Wind speeds are generally light. However, in locations exceptionally favorable to drainage flow, higher wind speeds may result.

The typical day flow is strongly influenced by surface heating. Solar heating of the surface and the layer of air near the surface tends to create a better mixing than the stable drainage flow. A neutral or unstable atmosphere is the result, and mixing is generally strong enough to cause the surface flow to link with the flow aloft, as far as terrain constraints will allow, resulting in a general flow from the southwest toward the northwest (fig. II-10). However, valley flow may alter this pattern. Day flow in rugged terrain tends upvalley.



Base from U.S. Geological Survey
Arizona, 1974, and Utah, 1969
State base maps 1:500,000

Figure II-9.--Air sub-basins and air quality monitoring stations.

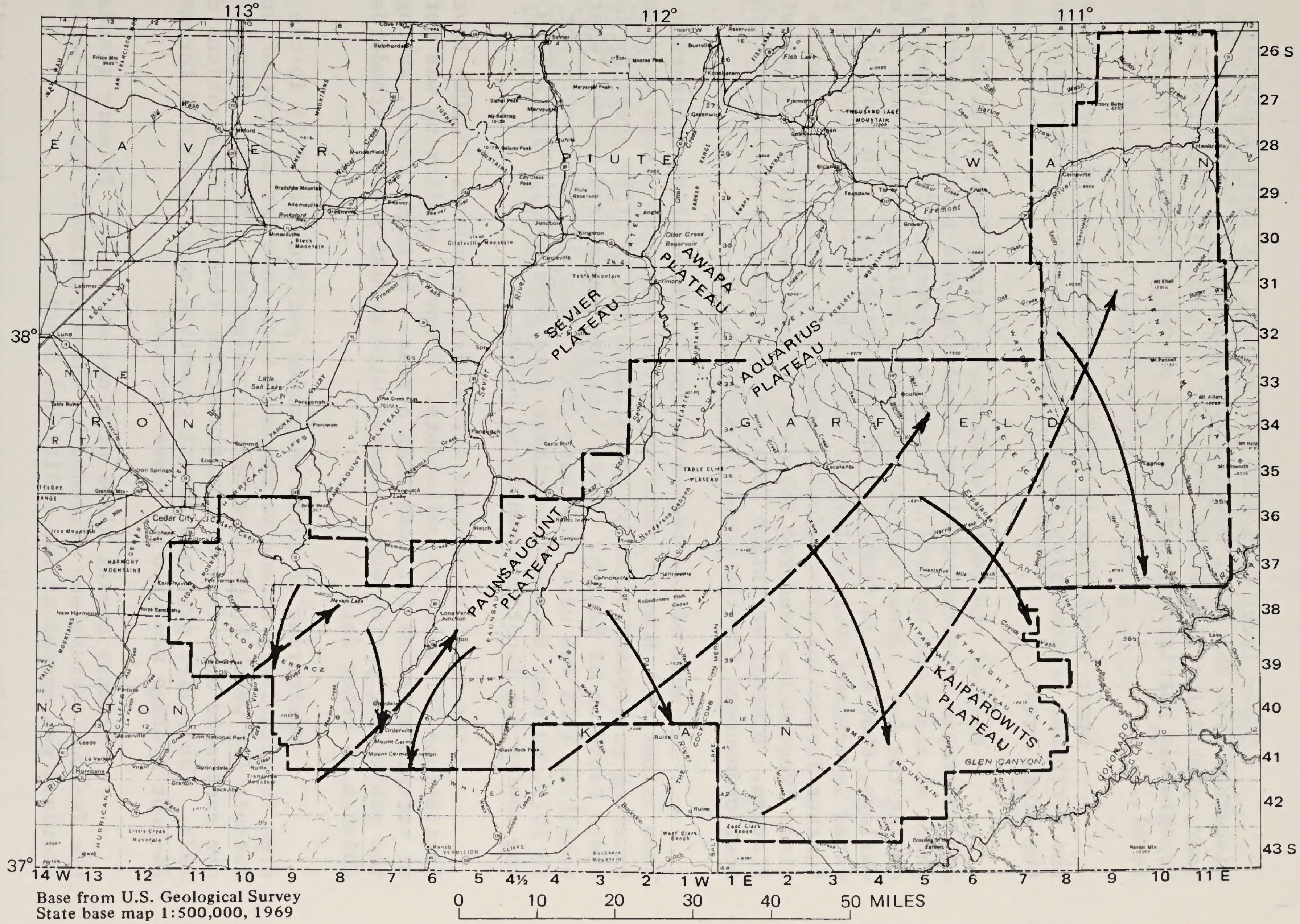


Figure II-10.--Streamlines for daytime and nighttime drainage flow.

Upper level wind data are scarce, but certain patterns can be discerned from the scant observations available. During most of the year, prevailing flow above 500 m AGL is generally from the southwest. Topographic barriers present less of an obstruction to flow at this level.

Upper level flow is different during the winters. Flow from the northeast predominates due to high pressure centered northwest of the study area.

Most of the region experiences strong insolation during the day and rapid nocturnal cooling, resulting in a generally stable atmosphere at night and neutral or unstable atmosphere in the lower layers during the day. Areas subject to strong drainage flow, such as mountain valleys, show a high frequency of night stability. In addition, elevated inversions over valleys or canyons may persist throughout the day, further increasing air-pollution potential. Table II-6 presents stability class frequencies measured February through June on the Kaiparowits Plateau. Diurnal variation from stable morning to neutral afternoon is most pronounced for the mountain stations.

As most of the region is rural, air-quality monitoring has not been extensive. However, monitoring has been done around proposed and existing powerplant sites by consultants and in other areas by the Utah State Division of Health. These data are summarized below. Wherever possible, 1975 was used as a base year. Many locations were not monitored in 1975, so most recently available data were used. Figure II-9 shows the monitoring locations mentioned below.

The National Ambient Air Quality Standards (NAAQS) have annual limitations for selected pollutants. However, monitoring was performed at certain stations for less than a year. In these cases, averages for the monitoring period were compared with annual average standards in the absence of other data.

Monitoring of total suspended particulate (TSP) in the study area is relatively extensive compared with that for many other pollutants for which NAAQS have been promulgated. TSP data from 10 stations are available and, five of these stations recorded observations during 1975. Table II-7 presents annual geometric mean (AGM) and the maximum 24-hour average measured at these stations.

Primary annual NAAQS were not exceeded. Primary standards for the 24-hour average was exceeded at three stations, and the secondary standard was exceed at two additional stations.

Sulfur dioxide ambient air concentration data are available from 10 locations near the study area and from nine of these for 1975. Table II-8 presents the annual average and maximum 24- and 3-hour averages for the monitoring period.

Table II-6.--Frequency of stability categories* for Four Mile and Nipple Benches, February to June 1974

[Source: U.S. Department of the Interior (1975): Final Environmental Impact Statement, Kaiparowits]

Location	Stability category*					Total
	1	2	3	4	5	
Four Mile Bench						
A.M.----------	0	4	31	21	3	59
P.M.----------	8	44	2	1	0	55
Nipple Bench						
A.M.----------	0	6	22	28	3	59
P.M.----------	2	48	3	0	0	53

*Category 1: Unstable
Category 2: Neutral
Category 3: Moderately stable
Category 4: Very stable
Category 5: Extremely stable

Table II-7.--Total suspended particulate maximuim 24-hour average and annual geometric mean, Southern Utah

[Values are in ug/m^3]

Location	Period of observation	Maximum 24-hr average	Annual geometric mean
Bullfrog--------	6/75-12/75	183	14
Caineville------	8/74-9/74	70	41
Cedar City------	1975	226	47
Fremont River---	[1]1974-1976	90	16
Leche-E---------	1972	78	34
Page------------	1975	742	41
St. George------	1976	131	22
Wahweap---------	1975	342	19
Warner Valley---	11/74-5/75	367	19
Wayne County----	Summer 1974	--	12
	Fall 1974	--	21

[1]Three seasons

Table II-8.--Sulfur dioxide annual average and maximum 24-hour and 3-hour average concentrations

[Values are in ug/m^3]

Location	Period of observation	Annual average	Maximum 24-hr average	Maximum 3-hr average
Bullfrog-----------	6/75-12/75	--	26	78
Caineville---------	8/74-9/74	13	13	13
Cedar City---------	1975	42	288	1,100
Four Mile Bench----	7/74-2/75	6	--	--
Fremont River------	[3]1974-1976	13	13	13
Nipple Bench-------	7/74-2/75	4	--	--
Page[1]--------------	1975	--	36	176
Page[2]--------------	1975	7	22	--
Wahweap------------	6/75-12/75	3	26	78
Warner Valley------	11/74-10/75	1	39	121

[1] Station west-southwest of Page
[2] Station at Page airport
[3] Three seasons

No exceedances of the NAAQS for SO_2 have been recorded in or near the study area.

Oxidants are primarily an urban pollutant. Only two stations near the study area have measured oxidants. Monitoring of ozone at Salt Wash and Page in 1975 has shown no NAAQS exceedance (table II-9). However, monitoring of proposed oil-shale tracts northeast of the study area (AeroVironment, 1976) has shown that ozone concentration in excess of the NAAQS can occur in very rural areas in Utah.

Four locations have monitored NO_2 near the study area, and NO_x has been monitored at one other (table II-10).

Annual averages are well below NAAQS. The highest 24-hour average was 96 ug/m^3 in Warner Valley, but this included NO as well as NO_2.

No data for carbon monoxide are available for the study area. As the area is rural however, carbon monoxide levels are probably low. Monitoring in other rural or suburban parts of Utah and Arizona has shown maximum 8-hour averages of 5 mg/m^3 at Lindon, Utah, 1 mg/m^3 at Florence, Ariz. and 3.7 mg/m^3 at the remote proposed oil-shale tracts in the Uinta Basin. Thus, exceedances of any NAAQS in the study area are unlikely.

Hydrocarbons have not been monitored in the study area, but relatively few automobiles and lack of industry indicate low concentrations. Measurements in the proposed oil shale tracts and in Florence, Ariz., however, have shown that the 6-9 a.m. NMHC may exceed NAAQS in rural areas. At the present time there is an inadequate data base with which to determine baseline pollutant concentrations in Class I areas.

Visibility has no NAAQS. However, visibility is a necessary esthetic, and "the prevention of any future, and the remedying of any existing, impairment of visibility in mandatory Class I Federal areas" has been declared a national goal in the Clean Air Act Amendments of 1977.

Degradation of visibility results mainly from scattering of light by gas molecules, fine particles, and liquid droplets, with adsorption of light being a factor in certain places, dense soot clouds, for example. Nitrogen dioxide also absorbs light (blue-green), giving the atmosphere a yellow-brown discoloration proportional to the NO_2 concentration. The conversion of SO_2 to sulfate also reduces visibility.

Measurements of visual range in the Huntington area, using light-scattering measurements from an integrating nephelometer, demonstrated an average of 67 miles during September 1970 to March 1971. Average visual range calculated from particle-size distributions at Bear Creek and Huntington Canyons in 1974 was approximately 45 miles.

Table II-9.--Maximum hourly oxidant concentrations (ug/m^3)

Location	Period of Observation	Maximum Hourly Average
Southern Utah		
Fremont River	1974-1976 (3 seasons)	131
Page	1975	80
Utah Oil Shale Tracts	1975	190

Table II-10.--Nitrogen dioxide annual average and maximum 24-hour concentrations (ug/m^3)

Location	Period of Observation	Average	Maximum 24-hour Average
Southern Utah			
Wayne County	1974	--	55
Warner Valley	11/74-10/75	--	96[1]
Page	1975	13	27
Caineville	Summer 1974	11	--[2]
Fremont River	1974-1976 (3 seasons)	14	--[3]

[1] NO_x

[2] Maximum hourly average was 39 µg/m^3.

[3] Maximum hourly average was 36 µg/m^3.

Analysis of photographs taken at Clawson, Utah, during January-June 1974 indicated 50-mile visibility 49 percent of the time. Visibility was below 5 miles only 12 percent of the time.

Visibility was measured in Page, Ariz., from 1970 through 1974. Local visual range (LVR) estimates obtained from integrating nephelometer measurements indicate median values exceeding 60 miles. Some reduction began in 1972. Estimates using a camera and telescope indicated an average LVR of 72 miles in 1974. Again some reduction began in 1972. A yellow discoloration associated with the Navajo generating station has also been observed. At the present time there is an inadequate data base with which to determine baseline visibility in Class I areas in southern Utah.

5. VEGETATION

Vegetative cover differs considerably over the region. Figure II-11 (in pocket) shows the distribution of vegetative types and endangered and threatened plants collected in 1977 (Welsh, 1977). It ranges from low desert shrubs to conifer stands. Vegetative production also ranges from 200 lbs/acre to 1,500 lbs/acre, dry weight. Change in altitude, with associated moisture and temperature changes is the chief factor in the variety of vegetative types. Topography, aspect, and soil modify variety. Typical vegetation changes with altitude are shown on figure II-12.

Eleven vegetative types were used to describe this region: 1) Nonproductive, 2) Agricultural land, 3) Streamside, 4) Grassland, 5) Desert Shrubs, 6) Sagebrush - Grass, 7) Pinyon - Juniper Woodland, 8) Mountain Brush, 9) Ponderosa Pine, 10) Aspen, 11) Conifer - Aspen.

A more complete listing of the common species in each type is contained in the Task Force files.

The Nonproductive type includes areas of little if any vegetation - rock outcrops, large bodies of water, roads, railroads, conveyors, buildings, and urban development. Many of these areas are too small to map separately.

The Agricultural Land type includes both irrigated and dry land farms, generally where soils are better in alluvial fans and valley bottoms. Because of the better soils, productivity is higher than the other vegetative types. Crops vary from dry and irrigated pasture to hay, small grains, some row crops, and a few orchards. Precipitation ranges from 6 to 16 inches per year and is usually supplemented by irrigation water. Very few acres of this type are found in the region.

Ground-cover varies with the crop and the season, although it is usually good to excellent during the growing season, unless the land lies fallow in summer. Poor ground-cover prevails after harvest.

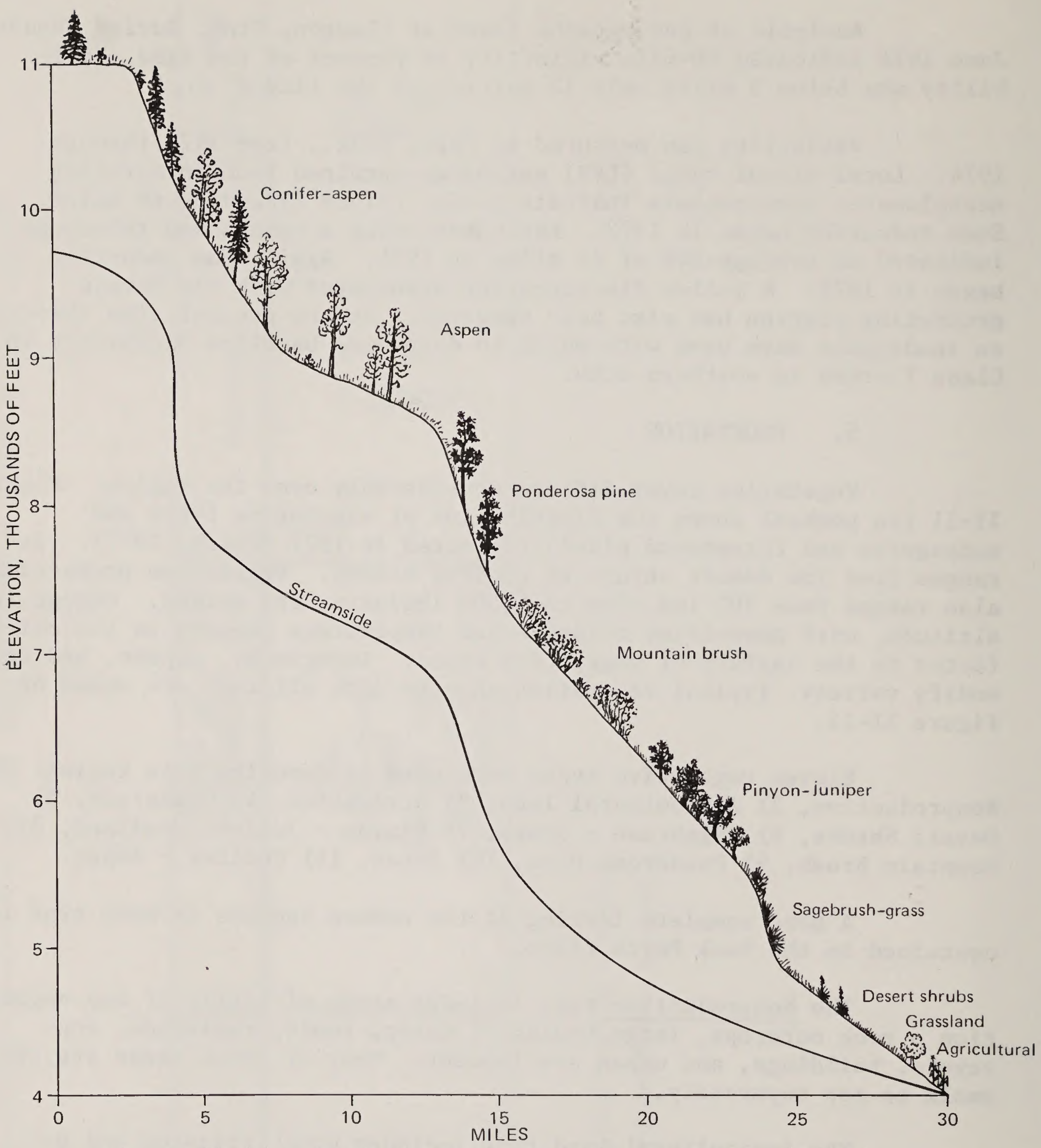


Figure II-12.--Typical vegetation changes with altitude.

The Streamside type occurs along the edges of streams and ponds or in areas of high water table. It includes areas that may be flooded. Sedges, rushes, horsetails and cattails grow adjacent to the water, along with willows, cottonwoods, saltcedar, and greasewood. Pondweed, algae, and mosses grow in the water. Soils are generally deep, soft sediments deposited by the water. Although widely scattered, very few acres of this type are found in the region.

This type grows within all precipitation ranges where streamflow provides enough moisture. It is found with or next to all other vegetative types. Because of the deep soils and high moisture content, this type produces an abundance of growth, which provides good to excellent ground-cover.

The Grassland type may be found scattered through the lower elevations, but it also includes seeded grasses in range-improvement projects at all elevations. Native grasses includes grasses in range-improvement projects at all elevations. Native grasses include galleta grass, sand dropseed, wheatgrasses, and threeawn, along with lesser amounts of forbs and shrubs. Ground-cover and production are generally low in the native grasses because of past disturbance. The seeded grasses are primarily crested wheatgrass at lower elevations and various mixtures at higher elevations, including intermediate wheatgrass, orchard grass, bluegrass, smooth brome, and Indian ricegrass. Ground-cover and production vary from poor to good, depending upon the species, management, precipitation, and success of seeding. The type grows in a range from 6 to 16 inches of annual precipitation. Soils are usually moderately deep and well drained.

The Desert Shrub type includes a wide variety of shrubs and some associated grasses and forbs. Species such as shadscale, blackbrush, rabbitbrush, big sagebrush, sand dropseed, and threeawn occur in this type. Moderately well-drained sites from the valley floors to the dry slopes of the foothills support much of this type, although some may grow on dry, impervious, saline soils. Large acreages are located in the southeast and east areas of the region.

As the plant density of this community is rather sparce, it has relatively low productivity. Erosion pavement covers much of its' habitat. Annual precipitation ranges from 6 to 12 inches.

The Sagebrush-Grass type grows generally between the Desert Shrub type and the Pinyon-Juniper Woodland type. Because sagebrush is aggressive, this type often extends through lower types along alluvial soil deposits and may grow to an elevation 9,000 feet. These communities are variable, but they generally occupy the deeper, more permeable, salt-free soils of well-drained valleys and foothills. Precipitation exceeds 12 inches annually or ample ground water is available. Species include big sagebrush, black sagebrush, rabbitbrush, Indian ricegrass, wheatgrass, Sandburg bluegrass, needlegrass, and blue grama.

This type, where undisturbed provides moderate ground cover and fair to good production. Much of the agricultural lands were once covered by the Sagebrush-Grass type.

The Pinyon-Juniper Woodland type forms an open forest, with trees 10 to 30 feet high. Shrubs, grasses, and forbs constitute a generally sparse understory, although dense stands of shrubs may occasionally be found on sites of high moisture content. This community mixes considerably with Sagebrush-Grass or alternates with it. Generally sandy, gravelly, or rocky soils prevail. Precipitation averages between 10 and 14 inches annually. This is the largest vegetative type in the Region and occupies vast areas at medium elevations.

Utah Juniper, Rocky Mountain juniper, and pinyon pine in various mixtures generally form the overstory. Buffalo berry, bitterbrush, cliffrose, sagebrush, galleta grass and Indian ricegrass form the understory. Productivity is generally low to moderate. This vegetative type is most often chosen as sites for revegetation projects to benefit livestock and wildlife.

The Mountain brush type occurs generally above the Pinyon-Juniper Woodland, but may alternate with that type as well as ponderosa pine stands. Dominant species differ with location, and often several species may grow at the same altitude. Deeper soils may allow sagebrush and grasses to join the overall community.

This vegetative type has a wide range of soil tolerance but generally grows on moderately deep, medium textured, well-drained soils. Common species are Gambel oak, mountain mahogany, mountain maple, sagebrush, bitterbrush, serviceberry, chokecherry, snowberry, bluebunch wheatgrass, and needle-and-thread grass.

Ground-cover and productivity are moderately high.

The Ponderosa Pine type is dominated by this tree. When mature, these large trees typically develop open, parklike stands, with a light understory of brush and (or) grass. It normally occupies favorable sites between the Mountain Brush and Conifer-Aspen types, although individual trees or groups grow with the other types. Precipitation ranges from 15 to 20 inches annually. A wide variety of soils support the type, but it prefers moist to dry gravelly loams. Other species include juniper, pinyon, Gambel oak, bearberry, bitterbrush, serviceberry, slender wheatgrass, and oatgrass.

Ground-cover and productivity are generally good. This, like other timber types, occurs on scattered sites at higher elevations.

The Aspen type grows mixed with Douglas fir, white fir, and spruces, over much of their common ranges. Occasionally, aspen dominates an area large enough to be mapped as a separate type. These pockets of aspen usually grow along streams, depressions, or flats, where soils are deep and moisture is abundant. Annual precipitation ranges from 20 to 40 inches. The conifers previously mentioned plus sagebrush, bluegrasses, Oregon grape, arnica, and larkspur grow in the aspen stands.

Ground-cover is generally good to excellent, and productivity is high.

The Conifer-Aspen type grows at higher elevations throughout the region. Various mixtures of tree species may generally be found separated by elevation. Engelmann spruce and alpine fir dominate the upper areas, whereas white fir, Douglas fir, and aspen dominate the lower, with considerable mixing in the middle. These trees generally require rather high moisture to grow and may be found on several deep soil types, which may or may not be well drained. Besides the trees, common juniper, deerbrush, pinegrass, elk sedge, and larkspur may be found with this type.

Annual precipitation ranges from 20 to 40 inches. Production is generally good, but the shorter growing seasons caused by higher elevations tend to reduce it.

Fires average 71 per year in the region. Approximately 30 percent of these are caused by man, the remainder by lightning. The average fire covers 20 acres in the more vegetated areas. The fire occurrence by land ownership follows:

National Forest	40
Public Lands	14
State of Utah	17
Private	unknown
TOTAL	71

Seldom do fuels above 8,000 feet become dry enough to sustain fires very long or over large areas. June 1 through October 31 is the time of greatest danger. At other times, when grass and other fuel become dry enough to burn, the cool nights tend to slow fire spread.

Historically, fire has affected the total plant community through repeated burning of some areas, which has kept vegetation in a subclimax stage. With better fire protection, vegetation has tended more toward climax, but better protection has allowed more litter to collect, which has the potential to produce larger and hotter fires.

The Endangered Species Act of 1973 authorized the Secretary of the Interior to designate threatened and endangered species (including plants). The Act also directed the Smithsonian Institution, in conjunction with other agencies, to prepare a list of plants considered to be threatened or endangered.

Threatened or endangered plants of the Southern Coal Lands and their environs were studied by Welsh (1977). These plants consist of perennial herbs, subshrubs, a few annuals, some shrubs, but no trees. All growth forms exist in arid or moderately moist sites, with aquatic and semiaquatic representatives lacking. There are 46 species or varieties cited in Federal Register publications as either threatened or endangered. Welsh states that 10 of the 18 species or varieties listed as endangered are judged as having critical current status, and 10 of the 28 species cited as threatened are probably critical. These plants are listed in table II-11, and the locations are shown on figure II-11.

Generally speaking, these plants do not grow in the same areas where coal is found. However, because of the lack of time for a comprehensive survey and the shortage of moisture during 1977, some of these plants may occur on lease or facility areas. Some of the threatened and endangered plants may grow on areas subject to urban development and recreational use.

6. WILDLIFE

Wildlife in the region is characterized by diversity of species rather than by density of populations. The region is home for a large variety of species due to the range of life zones from hot desert to high mountain forest. Species in the area include: mammals, 86; birds, 328; reptiles, 36; and amphibians, 11.

Only species of significant human interest, and unique, rare, or endangered species are discussed here. A complete list of wildlife species in the region is on file at the Task Force office.

A relatively large amount of data are available for game species; however these data were collected for management units that generally do not conform to boundaries of the impact area. Data relating to big game species, cougar, bear, and furbearers, are discussed in terms of Utah Division of Wildlife Resources (UDWR) management units. Information on upland game birds, waterfowl, cottontail rabbits, and snowshoe hare is given by counties, as compiled by UDWR. Figures on current population levels are not available; but trends are known, and relative abundance of game species can be inferred from harvest statistics. Harvest data, areas of occurrence, and associate vegetative types are presented in table II-12. Similar data for upland game and waterfowl are found in table II-13.

Table II-11. Summary of endangered (E) and threatened (T) plant species, status, County, and Critical Habitat.

Species		Status *	Cnty**	Critical Habitat
Astragalus ampullarius	(T)	C	W., K.	Chinle formation
Astragalus barnebyi 1/	(T)	C?	Wy., Ga.	Emery sandstone, Carmel, Morrison
Astragalus harrisonii	(E)	C	Wy.	Navajo sandstone
Astragalus lancearius	(T)	NC	K., W.,	Various
Astragalus loanus	(E)	NC	Wy., Ga., P., Se.	Volcanic gravels
Astragalus malacoides	(E)	C?	Kane	Mesaverde Group
Astragalus nidularius	(T)	C?	Ga., Wy., SJ.	Navajo sandstone
Astragalus pardalinus 2/	(E)	NC	Ga.	Sand
Astragalus perianus	(E)	C	Ga.	Volcanic gravels
Astragalus serpens	(E)	NC	Ga., I., K., P., Wy.	Volcanic gravels
Astragalus striatiflorus	(T)	C?	Ka., W.	Sand
Castilleja aquariensis	(E)	C	Ga.	Clay loam
Castilleja revealii	(E)	C	Ga.	Wasatch limestone
Cryptantha ochroleuca	(E)	C	Ga.	Wasatch limestone
Cymopterus minimus 3/	(E)	C	I.	Wasatch limestone
Cymopterus newberryi 4/	(T)	NC	Ga., K., W.	Various
Draba subalpina	(T)	C?	Ga., I., K.	Wasatch limestone
Erigeron flagellaria var. trilobatus	(E)	?	I.	Unknown
Erigeron relgiosus	(E)	C?	W., Ka.	Sand
Erigeron sionis	(E)	?	W.	Unknown
Eriogonum aretioides	(E)	C	Ga.	Calcareous outcrops
Eriogonum cronquistii	(E)	C	Ga.	Granitic pediments
Eriogonum panguicense var. alpestre 5/	(T)	C	I.	Wasatch limestone
Eriogonum thompsonae	(T)	C	K.	Chinle formation
Eriogonum zionis	(E)	C?	W., K.	Sand
Euphorbia nephradenia	(T)	NC	E., K., Wy.	Various, sandy
Geranium marginale	(T)	NC	Ga., I., K., Se.	Various
Gilia caespitosa	(E)	C	Wy.	Sand
Gilia mcvickerae 6/	(T)	C?	Ga., K., P., Se.	Modified volcanics
Haplopappus scopulorum	(T)	C?	I., K., SJ.	Various, sandy
Hymenopappus filifolius var. tomentosus 7/	(T)	NC	K., W.	Sandy
Lesquerella rubicundula	(T)	C	Ga., I., K.	Wasatch limestone
Lomatium minimum	(T)	C	Ga., I., K.	Wasatch limestone
Lupinus marianus	(T)	NC	P., Se.	Various
Nama retrorsum	(T)	NC	Ga., Gr., K.	Various, sandy
Penstemon caespitosus var. suffruticosus	(T)	C?	B., Ga., P.	Volcanic gravels
Penstemon leiophyllus	(T)	NC	Ga., K., I., W.	Various
Penstemon parvus	(T)	C	Ga., Wy.	Wasatch limestone, volcanic gravel
Peteria thompsonae	(T)	NC	E., Gr., K., W.	Various
Phacelia cephalotes	(T)	C	K., W.	Shale, clay, mudstone
Phacelia constancei	(T)	C?	E., Ga., K., SJ.	Shale, silt, mudstone
Phlox gladiformis 8/	(T)	C	Ga., I., W.	Wasatch limestone
Primula specuicola	(T)	C	Gr., K., SJ., Wy.	Hanging gardens
Psoralea epipsila	(T)	C	Kane	Shales, siltstones
Psorothamnus thompsonae 9/	(T)	NC	E., Ga., K., SJ., Wy.	Various
Viguiera soliceps	(E)	C	Kane	Tropic shale

* C = Critical, NC = Not Critical, ? = Uncertain

** County Abbreviations: B. = Beaver, E. = Emery, Ga. = Garfield, Gr. = Grand, I. = Iron, K. = Kane, P. = Piute, SJ. = San Juan, Se. = Sevier, W. = Washington, Wy. = Wayne.

1/ Published as Astragalus desperatus var. conspectus

2/ Published as Phaca pardalina

3/ Published as Aulospermum minimum

4/ Published as Peucedanum newberryi

5/ Published as Eriogonum pauciflorum var. panquicense

6/ Published as Bigelovia menziesii var. scopulorum

7/ Published as Hymenopappus tomentosus

8/ Published as Phlox longifolia var. gladiformis

9/ Published as Parosella thompsonae; better known as Dalia thompsonae

Table II-12.--Big Game

Species	Herd unit or area	Vegetation type	Hunting pressure 1976: Hunter days	Hunting pressure 1976: Percent of state total	Harvest 1976: Number	Harvest 1976: Percent of state total	Remarks
Mule deer a/	29, 50, 51B 52, 57B, 58, 59, 60A, 60B	Summer: Mountain Meadow, Conifer-Aspen, Aspen Mountain Brush. Winter: Sagebrush-Grass, Pinyon-Juniper, Mountain Brush.	41,051	6.0	2,922	5.1	Largest populations on Markagunt and and Paunsaugunt Plateaus, Kolob Terrace, and the Boulder Mountains. There is a total of ____ acres of summer range and ____ acres of winter range on these units.
Elk a/	16, 19	Summer: Mountain Meadow, Conifer-Aspen Winter: Sagebrush-Grass Mountain Brush.	1,955	2.0	32	1.3	Unit 16 (Dutton) has 362 mi^2 on National Forest Lands. Unit 19 (Cedar Mountain) has 576 square miles, of mostly private lands. Elk transplanted to Boulder Mountains during winters of 1976-77 and 1977-78,
	Boulder Mtn.		d/	d/	d/	d/	
Antelope	Johns Valley, East Clark Bench	Desert Shrub, Sagebrush-Grass Pinyon-Juniper	d/	d/	d/	d/	These herds are the result of transplants by UDWR (Johns Valley 1975, East Clark Bench 1970, 1971).
Bighorn sheep	Zion Park East Moody Canyon, Capital Reef, Rock Creek, Henry Mtns, Little Rockies.	Desert Shrub, Sagebrush-Grass Pinyon-Juniper Mountain Brush.	d/	d/	d/	d/	Population consists of scattered bands in remote canyons and plateaus.
Buffalo a/	Henry Mtns.	Pinyon-Juniper Sagebrush-Grass, Desert Shrub.	36	100	10	100	Transplanted in area in 1941-1942. Herd ranges primarily on west side of Henry Mtns.
Black Bear b/	Deer herd units 51B, 57B, 60A	Conifer-Aspen, Mountain Brush	4	0.6	0	0	Bear harvest for 10 year period, 1967-77, was 5 bear from deer herd units 51B and 57B
Cougar c/	Deer herd units 29, 50, 51B, 52, 57B, 58, 59, 60A, 60B	Same as mule deer	268	12.8	25	15.8	In the six-year period, 1971-1977, hunters took 161 lion (22% of total state harvest for that period) from this region.

a/ Big Game Harvest Report (UDWR, 1977a)
b/ Black Bear Harvest Report 1976-1977 (UDWR, 1977b)
c/ Cougar Harvest Report 1976-77 (UDWR, 1977c)
d/ No hunts held in these areas.

Table II-13.--Upland game and waterfowl in the Southern Region a/

Species	Vegetation type	Hunting pressure 1976		Harvest 1976		Remarks
		Hunter days	Percent of state total	Number	Percent of state total	
Cottontail rabbit	Agricultural land, streamside, Sagebrush-Grass, Pinyon-Juniper, Mountain Brush	12,116	9.6	15,856	6.7	Generally found throughout region at elevations below 8,000 feet.
Snowshoe hare	Conifer-Aspen, Mountain Meadow	544	2.7	536	3.5	Generally limited to the Markagunt and Paunsaugunt Plateaus, Kolob Terrace and the Boulder Mountains.
Ringnecked pheasant	Agricultural land	6,228	2.9	4,544	3.0	Most of the harvest (2.3%) comes from Washington County.
Quail	Agricultural land, streamside, Desert Shrub	2,785	21.0	6,215	43.0	Most of the harvest (40%) comes from Washington County.
Chukar	Grassland, Sagebrush-Grass, Desert Shrub, Pinyon-Juniper	943	2.0	1,312	3.0	In arid areas populations are associated with springs and perennial streams.
Mourning dove	Agricultural land, streamside, Pinyon-Juniper	7,506	6.9	27,462	9.2	Doves nest in the region during spring and summer and leave in the fall.
Band-tailed pigeon	Conifer-Aspen, Mountain Brush (7,000 to 9,000 feet elevation)	69	42.6	39	32.8	Pigeon densities are low, averaging two to four pigeons per square mile in areas of primary range.
Sage grouse	Sagebrush-Grass, Mountain Meadow, Streamside.	2,267	8.0	2,405	9.8	The largest populations are in Wayne and Garfield Counties.
Forest grouse	Conifer-Aspen, Mountain Meadow, Mountain Brush	1,241	2.2	1,396	2.2	Blue and ruffed grouse are in the region; however, ruffed grouse are uncommon residents in Southern Utah.
Turkey	Mountain Brush, Ponderosa Pine, Aspen, Pinyon-Juniper	209	65.0	18	86.0	The larger populations are on the Boulder Mountains and Kolob Terrace (East Zion) in Kane County.
Waterfowl c/	Streamside, Agricultural land, streams and bodies of water	3,529	1.5	4,448	1.0	Waterfowl habitat is limited; there are no developed waterfowl management units in the region.

a/ Harvest data is for Garfield, Iron, Kane, Washington, and Wayne Counties
b/ Harvest data from Upland Game Annual Report (UDWR 1977d)
c/ Harvest data are 10-year averages for period 1962-1971 (Jensen, 1974)

Data on nongame species are not generally available, and except in isolated instances, little quantifiable information on distribution, population numbers, and trends is known.

The region includes all or part of State deer herd units 29, 50, 51B, 52, 57B, 58, 59, 60A and 60B. Locations of these units and distribution of deer winter range are shown on figure II-13. Deer populations have trended downward in recent years, but studies by UDWR indicate that range conditions are good and that the range could support more deer.

Deer highway mortality is significant. During July 1, 1970, to June 30, 1976, an average of 163.5 deer per year were killed by vehicles. The magnitude of this loss is compounded by the fact that approximately 50 percent of the total reported casualties were mature does.

Elk are found in limited numbers in the region. Two elk herd units, where hunting has been allowed, are within or adjacent to the area. During the winters of 1976-77 and 1977-78, the UDWR transplanted 150 elk to the Boulder Mountain area. Its success cannot be determined at this time. Distribution of big game animals is shown on figure II-14.

Limited populations of antelope are found in Johns Valley, and on East Clark Bench. Bighorn sheep were widespread in Southern Utah before white men first came to the area. The larger populations are east of the Colorado River, and expansion to the west is blocked by Lake Powell.

Buffalo were transplanted to the Henry Mountains in 1941 and 1942. The first hunt was held in 1950, and a restricted harvest has been allowed since that time.

Mountain lion (cougar) are found throughout the region where suitable habitat exists. Mule deer are their principal prey, and lion are usually associated with deer populations in remote areas. Cougar population characteristics and distribution data are not available for Utah, but studies in neighboring states have provided some applicable data. Studies of hunted cougar populations in California, Nevada, Idaho, and British Columbia showed home range sizes from 15 to 43 square miles. Some lions ranged as much as 175 square miles (USFWS, 1976). In their studies in a wilderness area in Idaho, Siedensticker and others found that yearly home areas of individual animals ranged from 67 to 175 square miles. They found that resident female home areas often overlapped completely and were also overlapped by resident male home areas; however, the lions avoided each other. It was concluded that the home area used by resident cougars, as well as the degree of home area overlap, was determined by a complex of vegetation, topography, prey numbers, and prey vulnerability (Siedensticker and others, 1973).

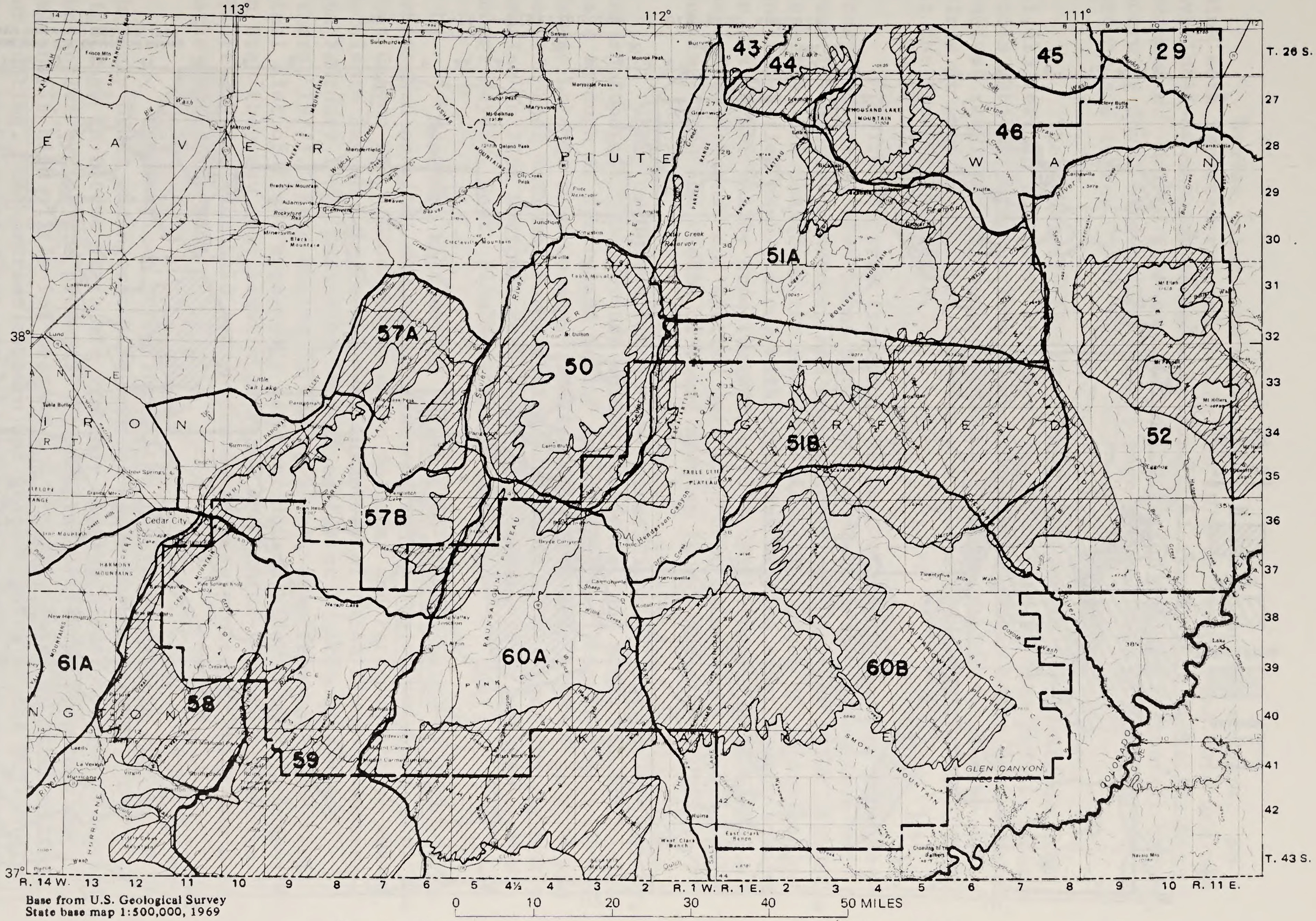
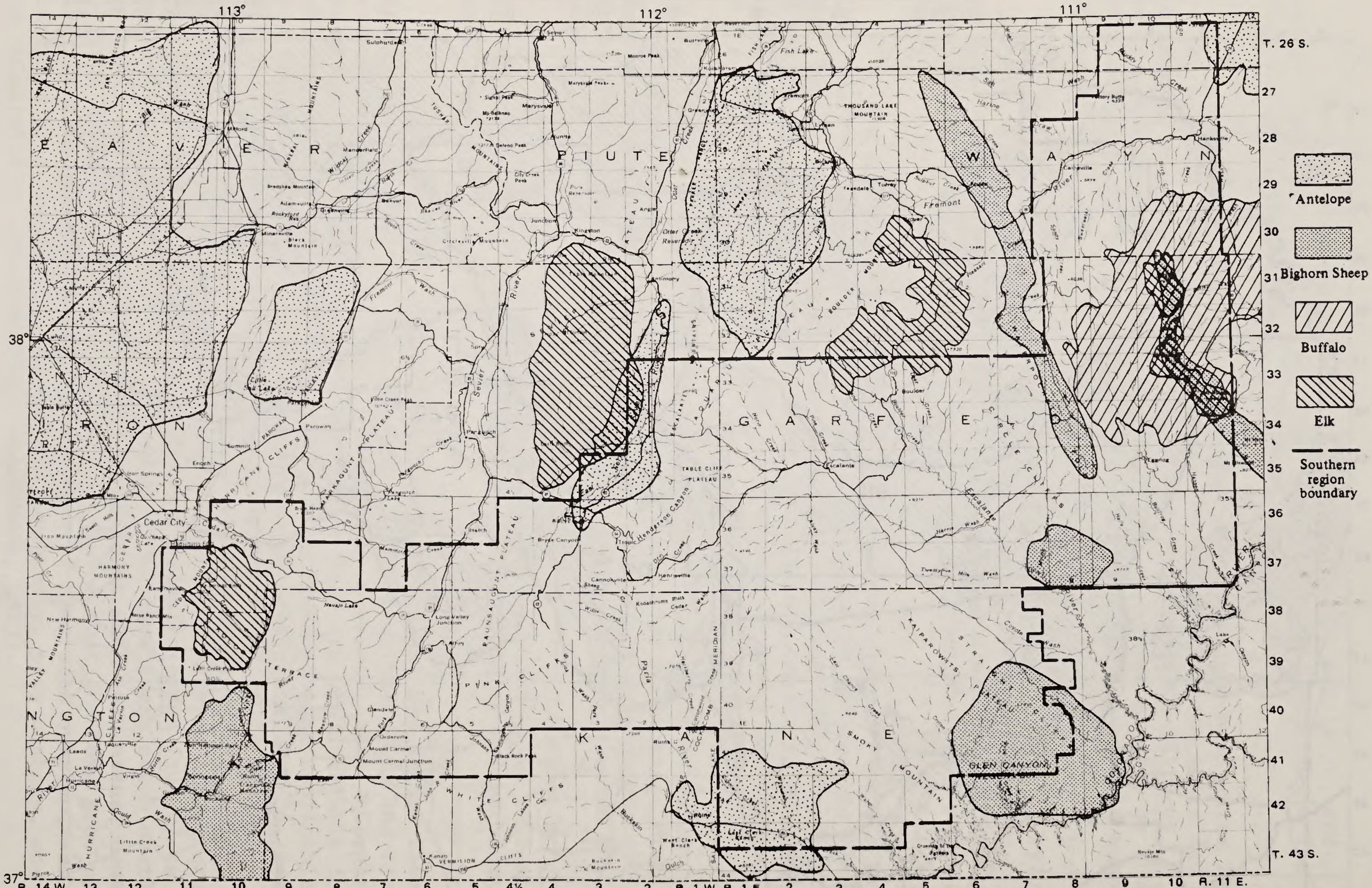


Figure II-13.--Deer Management Areas and Mule Deer Winter Range



Base from U.S. Geological Survey
State base map 1:500,000, 1969

Figure II-14.--Distribution of big-game animals

Beaver, mink, and muskrat are found in sparse numbers. No mink were reported trapped during the 1975-76 season, and data are not available on muskrat trapping. Commercial trapping of beaver is not extensive. Upland game species in the region include cottontail rabbit, mourning dove, band-tailed pigeon, sage grouse, blue grouse, ruffed grouse and turkey.

The diversity of life zones, represented by elevations from 11,615 feet in the Henry Mountains to 3,600 feet at Lake Powell, provides habitat for a variety of nongame birds. These birds have diverse habitat requirements; consequently, all of the region is used by some birds at various times of the year. A list of bird species is on file at the Task Force office.

Birds of prey (raptors), because of their size and general conspicuousness, have human interest. Raptor nesting sites have not been inventoried, however, and population trends are not known. Studies in early 1977 confirmed the presence of nesting pairs of golden eagle and red-tailed hawks, along with sightings of five other raptor species in the Warner Valley area (Wagner, 1977). Sightings of bald eagles, peregrine falcons, and spotted owls have been documented, as well as nesting sites and roosts of these species (Boner and others, 1977).

Rare or unique birds (UDWR classification) include the osprey, and spotted owl. Osprey are summer residents, and migrating birds also pass through in spring and fall. An active nest is located east of Navajo Lake in Kane County. Spotted owls have been sighted in Zion and Capitol Reef National Parks during surveys in 1977. They are currently nesting in Zion National Park (Boner and others, 1977; written commun., Robert Heyder, Supt. Zion Nat. Park, 1977).

Northern bald eagles (Haliaeetus leucocephalus alascanus), an endangered species, are winter visitors in the region and throughout the Glen Canyon NRA. Roost sites exist in Cedar and Parowan Valleys and at Escalante Bay on Lake Powell. An inventory of these sites in January and February 1977, indicated 64 bald eagles at 8 sites (Boner and others, 1977). Bald eagles in desert areas, away from water and their usual diet of fish, apparently eat carrion and black-tailed jackrabbits. In Utah they may rely heavily on road- and hunter-killed jackrabbits. (Platt, 1976). The bald and golden eagles are protected under the Bald Eagle Protection Act.

The American peregrine falcon (Falco peregrinus anatum) is the only other endangered bird species known in the region. Most sightings in recent years are probably migrant birds; however, at least two active eyries are present. The habitat preferred by peregrine falcons is high cliffs for nesting and a river, lake, or marsh nearby for hunting. The extreme eastern and western parts of the region are part of the known and suspected breeding distribution of the peregrine falcon in Utah (Porter and White, 1973).

Several species of small mammals, such as mice, rats, squirrels, shrews, moles, bats, gophers, and rabbits, are distributed throughout the region. Many of these are prey for raptors, badger, fox, coyote, bobcat, and skunk. Rabbits, bobcat, fox, and coyote are hunted or trapped for sport and pelts. The high price of bobcat pelts has led to their increased hunting and trapping and declining population.

The unique (UDWR classification) spotted bat (Euderma maculatum) has been sighted in Garfield, Kane and Washington Counties (Poche 1976; Easterla, 1965). Fort Pierce wash in southern Washington County may support the largest spotted bat population in Utah, but studies in other parts of the region failed to locate spotted bats. (Boner and others, 1977).

The Utah prairie dog (Cynomys parvidens), an endangered species, is found in the region. The principal concentrations of prairie dog towns are in Parowan and Cedar valleys, the Bryce Canyon-Johns Valley area, and Sevier Valley from Panguitch to Long Valley Junction. The fall 1977 census yielded the largest count (3,429 dogs) since UDWR began such counts in 1975. This increase is attributed to the discovery of new towns and establishment of transplant sites on public lands (Boner and others, 1977). Maps indicating locations of Utah prairie-dog towns are on file at the Task Force Office.

Two bands of wild horses (at least 17 animals) have been located. One band is in the Circle Cliffs area west of Capitol Reef National Park in Garfield County. The other is in the Rock Creek area of the Kaiparowits Plateau in Kane County.

A total of 36 species of reptiles and 11 species of amphibians are in the area. They feed on vegetation, insects, fish, small mammals, reptiles, and amphibians, and are, in turn, prey for predatory mammals and birds. No threatened or endangered reptiles or amphibians are known in the region.

The protected Gila monster and desert tortoise are found in the warm desert habitat of southwestern Washington County, Nevada, and Arizona. The status of these reptiles is undetermined, but population densities are low (Coombs, 1976).

The direct loss of wildlife from illegal shooting, highway mortality, and other activites would increase. Rare or unique species in small numbers may be eliminated.

Range improvements, water developments, and better management practices will increase habitat and carrying capacities of some wildlife. Planned transplants will increase the range of some species and introduce new ones into the area.

7. FISHERIES

Waters known to support fish in the region includes parts of the Colorado River and Great Basin drainages (fig. II-15). Fish known within the region and those immediately outside it in water originating in the region include about 40 varieties (McAda and others, 1977). The better known are cutthroat, rainbow, brown, and brook trout; channel catfish; red shiner; speckled dace; flannelmouth suckers; largemouth bass; green sunfish; and the endangered woundfin. Although not now officially listed as endangered, the rare Virgin River roundtail chub and Virgin River spinedace are also present and have been proposed for endangered status.

Major tributaries to the Colorado River system with parts in the region, include the Dirty Devil, Escalante, Paria, and Virgin Rivers and Kanab Creek. In general, tributaries in the headwaters of these major streams are cool and clear and are often capable of supporting trout. As stream-flow increases downstream, irrigation withdrawals begin, preventing stream growth. Upper midsections of streams are usually dewatered. Downstream water characteristics include warm temperature, high turbidity, heavy sediment load, high hardness and conductivity, drastically fluctuating flow, with many sections dewatered at times and rarely containing fish.

Instream flow to support fish is not recognized as a "beneficial use" of water under Utah laws. All water may be withdrawn and used for any legally defined "beneficial use" without regard to fish.

The uppermost part of the Colorado River receives water from the region at the mouth of the Dirty Devil River at Lake Powell. Fish habitat in the Dirty Devil River, lower Muddy Creek, and the Fremont River is quite poor and does not support gamefish or endangered fish. These streams are broad and shallow, with few pools, and have large sections that dry up during the summer. The stream bottoms are mostly shifting sand and silt throughout.

Gamefish inhabit the Fremont River tributaries, Pleasant and Oak Creeks. Fish in the Escalante River system were investigated by McAda and others in their survey of fish in the southeastern Utah streams (McAda and others 1977). It provides most of the fish data for this stream system. Although occasional trout are found in the Escalante, it is not classified as a sportfish stream by the Utah Division of Wildlife Resources. There are no reported endangered fish in the river.

Seven tributary streams to the Escalante River have fish populations: Deer, Calf, Sand, Death Hollow, Pine, North, and Birch Creeks. Sections of Boulder and Pine Creeks are dewatered for irrigation, whereas sections of Sand, Lake, and Death Hollow Creeks have slickrock substrates and steep gradients, limiting their capacities to produce fish.

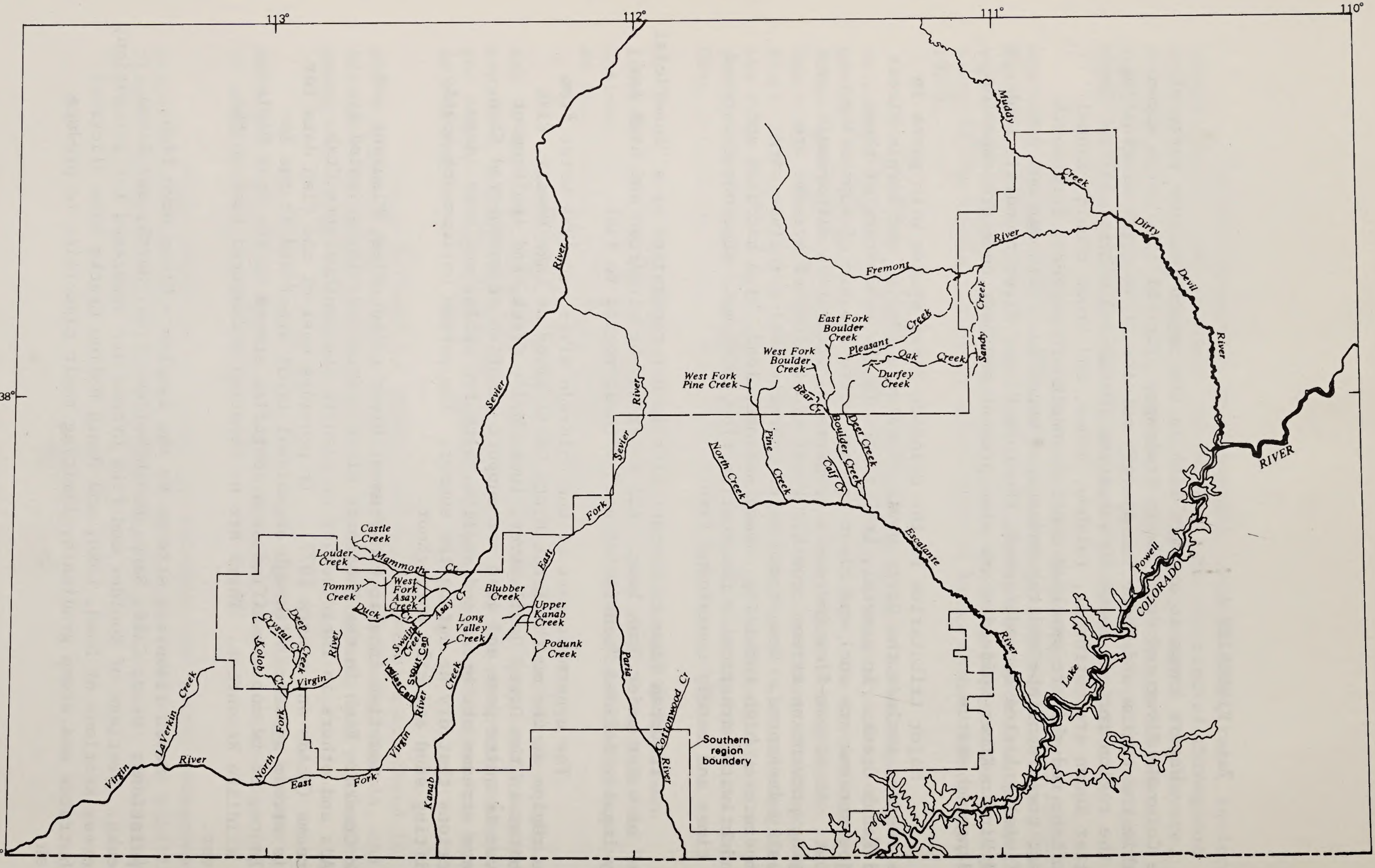


Figure II-15.--Waters with fishery values.

Lake Powell, although outside the region, must be considered in discussion of impacts from coal development on fish. The fishes are mostly warm water varieties, although some hatchery rainbows are released near the dam, and striped bass (a sea bass) have been introduced. Major warm water fish include largemouth bass, black crappie, channel catfish, walleye, and threadfin shad. Endangered Colorado squawfish and humpback chubs are occasionally recorded. Lake Powell has little productive littoral zone considering the size of the impoundment. Wahweap and Warm Creek bays have extensive littoral zones.

Mercury exceeding the levels considered safe for human consumption has been found in some Lake Powell gamefish. Mean mercury level in Lake Powell water is about 0.01 part per billion (ppb) but it is bio-accumulated through the food web until concentrations of over 500 ppb occurs in some large walleye and largemouth bass (Standiford, 1973). Bussey and others found selenium levels in edible portions of Lake Powell fishes exceeding the toxic safety threshold (Bussey and others 1976). They also found high lead levels in the gills of three species, which is indicative of recent exposure to high lead concentrations in the water. Data showed a correlation between the lead content in the surface water and recreational use of the reservoir. They proposed that the high levels in the gills resulted from outboard motors.

Lake Powell's sportfishery is now fished below its capacity to provide excellent warm water fishing. It should continue to provide fishing near the current level for the projected 1990 population of southern Utah, provided coal is not developed.

The Utah Division of Wildlife Resources does not classify the Paria River as a gamefish stream, and in McAda's survey (1977) they found only speckled dace at six sampling stations, both inside and outside the region. The Arizona Game and Fish Department attempted to establish woundfin (Plagopterus argentissimus) in the stream, but was unsuccessful (McAda and others, 1977).

Little information on fish in Kanab Creek is available; however, it is known that a 3-mile section in the headwaters supports a fishable, self-sustaining population of cutthroat trout. The size of the stream limits its sportfish value.

The Virgin River is the lowermost tributary to the Colorado River that receives waters originating in the region. It begins at the confluence of the North and East Forks of the Virgin River and terminates at Lake Mead. The Virgin River is of critical fishery value because it is the only stream supporting a population of the endangered woundfin (Plagopterus argentissimus). Notice of intent to declare the main channel of the Virgin River, from the crossing of U-15, near Hurricane Utah, to Lake Mead, and a part of its La Verkin Creek tributary critical habitat for the woundfin was published in the Federal Register November 2, 1977, Vol. 42, No. 211, pages 57329-57330. The stream is also populated by the unique Virgin River roundtail chub and the Virgin River spinedace, which have been recommended for inclusion on the endangered species list. According to Cross, the Virgin River roundtail chub may be the most threatened of these three rare fish (Cross, 1975).

Low water and competition from introduced exotic fish are threats to the endangered woundfin and Virgin River roundtail chubs. Woundfin can tolerate conductivity up to 12,000 micromhos, but less than 4,000 is probably preferred.

Water temperature is important to fish. High temperature and low flows often occur together in mid-summer. The temperatures may reach 91°F in July, while the flow of the Virgin River is 50 cfs or less. Lethal temperature for woundfin is 94°F but a temperature over 86°F for extended periods is probably unsuitable.

Virgin River tributaries originating in the region having gamefish and (or) endangered fish are La Verkin Creek, North Fork of the Virgin River, and East Fork of the Virgin River.

La Verkin Creek is populated by endangered woundfin, Virgin River roundtail chubs, Virgin River spinedace and other nongame fish.

The North Fork of the Virgin River and its tributaries, Deep, Crystal, and Kolob Creeks, are populated with rainbow, brown, and cutthroat trout; Virgin River Spinedace; desert suckers (Pantoesteus clarki); and other fish. The North Fork system has 78 stream miles of classified sportfish waters, but most of the streams are small, and fishing is restricted. Upper Kolob Creek is a major cutthroat spawning area for Kolob Reservoir; below the reservoir it is not recognized as a sportfish stream.

The East Fork of the Virgin River and its tributary system of Long Valley and Stout (Main) Canyon Creeks are inhabited by rainbow and brown trout, Virgin River spinedace, speckled dace, and flannelmouth and desert suckers. This system has 24 stream miles of classified sportfish waters, but most of the gamefish streams are small, and fishing is restricted. The lower 17 miles of the East Fork is populated with minnows and suckers. A 5-mile section between the Orderville diversion and Orderville bridge is periodically dried up by irrigation withdrawals.

The Sevier River is in a closed basin that once terminated in Sevier Lake northwest of Milford. Irrigation use now prevents the streamwater from reaching the lake. Fish life in the Sevier system varies from headwaters to terminus. Available water limits fish in the Sevier drainage. Trout streams are probably fished at or above their production level now. These streams are unlikely to produce any more trout by 1990.

Garfield, Iron, Kane and Washington Counties have 60 reservoirs and(or) lakes classified as gamefish waters, excluding Lake Powell. Most are trout waters; however, several have warm water species. Only 5 of these reservoirs cover more than 200 acres and more than half of them cover less than 5 acres.

8. INVERTEBRATES

Two snails were proposed for listing as endangered and(or) threatened: the St. George (Fontelicella deserta), and the Zion (Physa zionis). The latter snail is found only in Zion National Park and will not be impacted by coal development. A new species of Fontelicella, closely related to the St. George snail, has recently been discovered; it will probably be proposed for listing when it is described. Final ruling on these species is pending.

Aquatic mollusks in southwestern Utah, as in many western areas, have extremely small distribution. The St. George snail is known only from seven springheads and(or) upper spring runs, whereas the new snail is known only from six different, but similar, habitats. These snails are unique because they represent paleontologically old forms and specialized evolutionary features.

B. CULTURAL ENVIRONMENT

1. LAND

No prime farmlands have been identified on areas that would be affected by the proposed mining activities according to available soil surveys and consultation with the Soil Conservation Service (1978). Most of the alluvial valleys have deeply entrenched drainages and do not have high enough water tables to qualify them as alluvial valley floors as defined in the SMCRA of 1977. Sagebrush is the most common native plant on these soils rather than riparian species.

There are approximately 4 million acres within the boundary of the region. Table II-14 lists the acreage by ownership and managing agency (figure II-16 in pocket).

2. AGRICULTURE, RANGE, AND TIMBER

Historically, the livestock industry has been an integral part of the region's economy. Early settlers depended on range land for grazing sheep, cattle, and horses. As time passed, grazing operations became smaller, more numerous, and directly associated with small farms.

As the old timers passed on, operations were further distributed among descendents until about 1960, when consolidating into larger operations began.

There are five natural areas on public land in the region: Escalante Canyon, North Escalante Canyon, Joshua Tree, The Gulch, Phipps Death Hollow, and Devil's Garden (fig. II-17). They will be studied for their wilderness suitability or nonsuitability by the BLM prior to 1980 as required by the Federal Land Policy Management Act (FLPMA) of 1976. Several of these areas are contiguous to a large existing acreage of unroaded area. These areas are between Alvey Wash and Straight Cliffs southeast of Escalante town proper; the area within Circle Cliffs northeast of Escalante; lands north of Highway 12 to the Dixie National Forest; and lands surrounding Devil's Garden and north to North Escalante Canyon.

The USDA Forest Service RARE II study has identified two roadless areas on the Dixie National Forest within the Southern Coal Regional Boundary namely, Henderson Canyon area (#4-258), and Box Death Hollow (#4-259) (fig. II-17). The management direction for these areas is to maintain their wilderness character until a decision is made in the study regarding their future management.

Table II-15 shows the regional trend in livestock over the last 20 years.

Table II-14.--Landownership acreage for the Southern Utah Coal Region

BLM	2,603,520	65% Total
USFS	460,800	11% Total
NPS	276,480	7% Total
Total Federal	3,340,800	83% Total
Total State	443,520	11% Total
Total Private	253,440	6% Total
Total in Region	4,037,760	

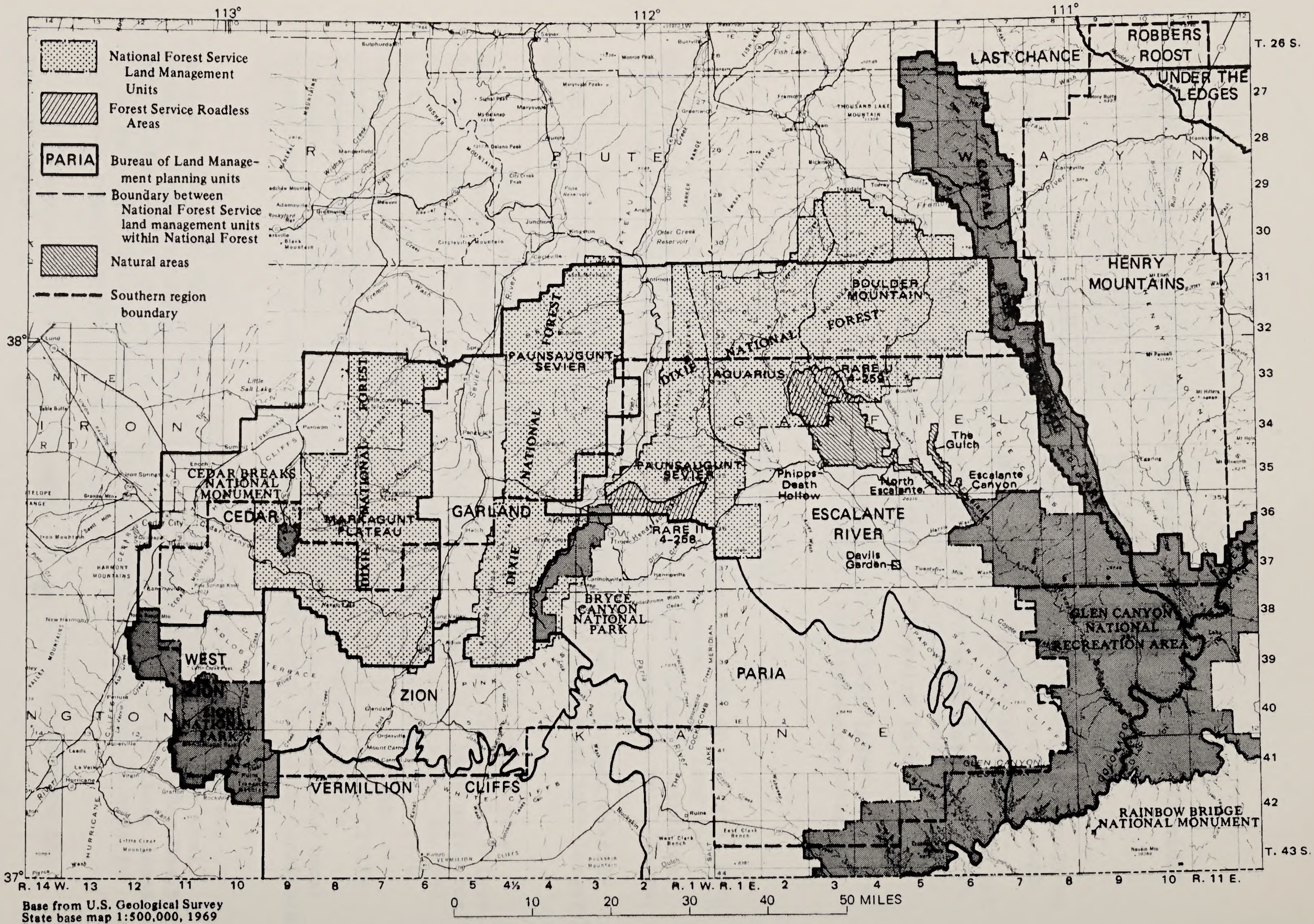


Figure II-17.--Planning units and USFS RARE-II areas.

Table II-15.--Livestock numbers by county and year[1]

County	1959	1969	1974
	Sheep and lamb numbers		
Garfield	20,682	13,778	6,561
Iron[2]	88,833	62,270	54,438
Kane	15,212	9,611	5,583
Washington[2]	6,680	2,151	1,653
Wayne[2]	27,096	14,440	14,029
Total	158,503	102,250	82,264
	Cattle and calve numbers		
Garfield	19,600	16,619	19,286
Iron[2]	16,680	22,420	21,853
Kane	12,665	10,042	13,113
Washington[2]	32,558	18,670	19,925
Wayne	12,841	13,120	12,748
Total	94,344	80,871	86,925

[1] Utah Agricultural Statistics, State of Utah, Department of Agriculture, for the years shown.

[2] A small portion of Iron, Washington, and Wayne Counties are included in the region. Although a small portion of Emery County also falls within the boundary, the statistics were not included here.

Ranchers usually base their operations adjacent to or within a few miles of their grazing areas, although some trail or truck stock considerable distances. A typical operation would start out on public lands (BLM) early in the spring, move up to the National Forest (FS) for the summer, return to the public lands in the fall, and then winter on their own lands. Some livestock will graze on private, State, or Federal ranges for the entire year.

The actual livestock use on and adjacent to the mines is shown on table II-16.

Historically, timber has also been an integral part of the economy of the region, but on a much smaller scale than the livestock industry. Early settlers needed fenceposts, corral poles, house logs, mine timber, railroad ties, and boards; numerous small sawmills supplied local needs. As time passed and needs changed, most mills went out of business. A few are still in operation. There is one large mill in Panguitch.

Current uses of the forests include mainly fenceposts, poles, Christmas trees, and sawtimber.

3. COAL MINING METHODS

The following is a brief discussion of mining methods currently being imployed in Utah. These same methods will be used in the new mines if the proposed actions are approved. Most underground coal mining in Utah is by room-and-pillar methods, using continuous mining machines. In room-and-pillar mines, the mined panels are open spaces or rooms; the pillars are supportive walls of unmined coal that are left to prevent cave-in. Longwall or shortwall mining methods may be used where mining conditions are suitable; where these methods are used, the mined panel is supported artificially, and it is allowed to collapse as support is withdrawn. Longwall mining is a full extraction method. Coal is mined in a single cut, and no pillars are left; caving is induced or permitted on completion of mining. The block of coal to be mined is generally 300 to 600 feet wide and between 2,500 and 7,500 feet long. Shortwall mining is a modification and combination of continuous and longwall mining; it uses smaller blocks than longwall mining, generally up to about 100 feet wide and 3,000 feet long. The various underground mining methods were discussed by Cassidy, 1973.

Mined coal is brought to the surface by electric conveyors or trains. At the surface, in preparation plants in the mine plant area, the coal may be crushed to uniform size and screened to remove waste rock. It may be washed to remove waste rock, dust, and sulfur, or it may be delivered after crushing, without washing. Dry waste is disposed of in land-fill areas. Wet waste is disposed of in settling ponds, and the water may be recycled. Coal preparation was discussed by Leonard, 1968.

Table II-16.--Domestic livestock use[1]

Project	Kinds and numbers	Season	AUM's[2]	Percent of total
1. Alton------	1,110 cattle	Summer, about 4.5 months	5,130	67
2. El Paso---- (Blue)	225 cattle	10/16 - 2/28	1,010	13
3. Mono-------	220 cattle	11/01 - 5/31	1,550	20
Total------	1,555 cattle	--	7,690	100

[1] This table shows the actual use by cattle on and adjacent to the lease areas of the mines listed.
[2] Glossary.

Basic mine-support facilities include an office building, maintenance shop, bathhouse or wash room, storage yard, stockpiles, preparation plant, and tipple and housing for the underground ventilation system. The surface area required for these various facilities depends upon the amount of coal preparation needed, size of stockpiles, and layout selected. A typical arrangement would require about 40 acres.

Although there are no strip mines in the region, a brief description of this mining method is given since there are coal beds where such mining could be undertaken.

In areas being strip mined, vegetation and overburden are removed to the surface of the coal bed. The ratio of overburden removed to thickness of coal is currently 8 to 12 to 1 in western coal fields with geologic conditions similar to those in Utah.

Unconsolidated material is generally removed by scrapers or front-end loaders and trucks. If necessary, level spots or benches are created by bulldozers to accomodate drilling equipment. The overburden, if consolidated, is broken by drilling and blasting. The broken overburden is removed by mechanical shovels, front-end loaders, or draglines. It is hauled from the pits by trucks and dumped, usually adjacent to the initial cut. Overburden from subsequent cuts is usually used to fill cuts that have been mined-out.

After the overburden is removed, the coal is broken by drilling and blasting or by other mechanical means. The broken coal is removed by dragline, shovel, or backhoe and loaded into trucks for transportation to a processing plant.

Strip mining methods were described by Pfleider, 1968.

4. SOCIOECONOMICS

The coal mining potential in southern Utah occurs in an economic region containing Beaver, Garfield, Iron, Kane, and Washington Counties. It is the largest and least densely populated region in the State. The coal fields are located in Kane and Garfield Counties. These counties are geographically isolated from the more populated Washington-Iron County area by absolute distances and by rough terrain. Figure II-18 identifies the region.

The region had a 1970 population of 35,224 which occupied an area of 17,373 square miles, resulting in a population density of 2.0 persons per square mile. By contrast, the United States--including Alaska and Hawaii--had a 1970 density of 57.5 persons per square mile.

Garfield and Kane Counties are even more thinly populated than is the region as a whole. With respective land areas of 5,158 and 3,904

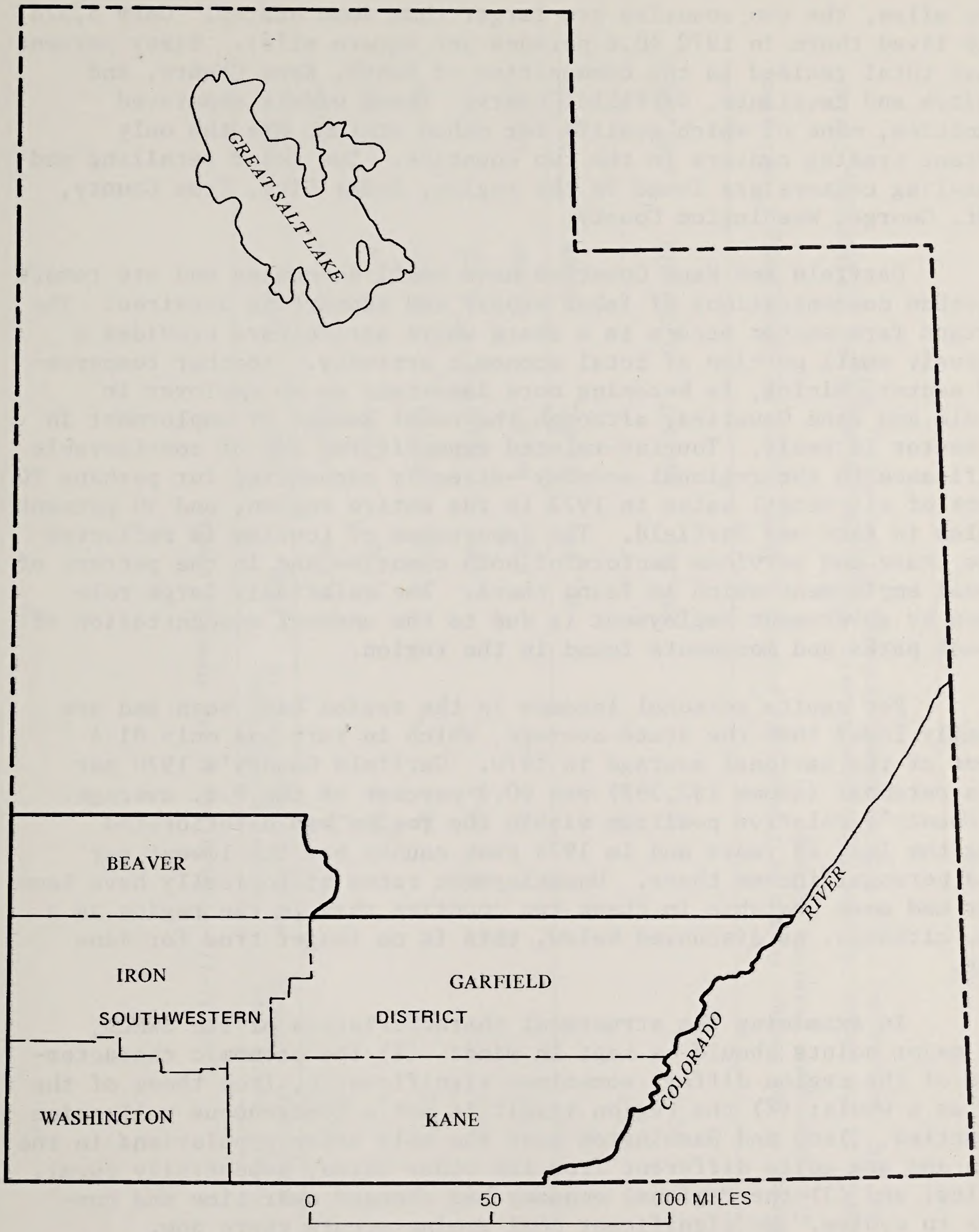


Figure II-18.--Southwestern planning district and counties.

square miles, the two counties are larger than some states. Only 5,578 people lived there in 1970 (0.6 persons per square mile). Sixty percent of that total resided in the communities of Kanab, Kane County, and Panguitch and Escalante, Garfield County. These widely separated communities, none of which qualify for urban status, are the only important trading centers in the two counties. Two major retailing and wholesaling centers are found in the region, Cedar City, Iron County, and St. George, Washington County.

Garfield and Kane Counties have small economies and are remote from urban concentrations of labor supply and supporting services. The important farm sector occurs in a state where agriculture provides a relatively small portion of total economic activity. Another resource-based sector, mining, is becoming more important as an employer in Garfield and Kane Counties, although the total amount of employment in that sector is small. Tourist-related expenditures are of considerable significance to the regional economy--directly accounting for perhaps 20 percent of all retail sales in 1972 in the entire region, and 50 percent of sales in Kane and Garfield. The importance of tourism is reflected in the trade and services sectors of both counties and in the pattern of seasonal employment which is found there. The relatively large role assumed by government employment is due to the unusual concentration of national parks and monuments found in the region.

Per capita personal incomes in the region have been and are presently lower than the state average, which in turn was only 81.4 percent of the national average in 1970. Garfield County's 1970 per capita personal income ($2,397) was 60.4 percent of the U.S. average. Kane County's relative position within the region has deteriorated during the last 25 years and in 1975 that county had the lowest per capita personal income there. Unemployment rates historically have been higher and more unstable in these two counties than in the region as a whole, although, as discussed below, this is no longer true for Kane County.

In examining the structural characteristics of the SWMCD, three major points should be kept in mind: (1) the economic characteristics of the region differ, sometimes significantly, from those of the state as a whole; (2) the region itself is not a homogeneous collection of counties. Iron and Washington have the only urban populations in the region and are quite different from the other three, essentially rural, counties; and (3) the regional economy has changed over time and continues to evolve. No significant coal mining occurs there now.

a. Regional Demographic Characteristics

The population of the region has increased slowly since 1950. Since 1970, fairly rapid growth has occurred in three of the counties and small but positive rates of growth have occurred in Beaver and Garfield Counties. Table II-17 shows population totals and rates of growth for the five counties, the region as a whole, and the entire state.

Table II-17.--Population of the SWMCD by county

County	Annual Growth rate of population, 1950-70	Annual growth rate of population, 1970-75	1950	1960	1970	1975
Beaver	-1.2	+1.3	4,856	4,331	3,800	4,086
Garfield	-1.4	+0.8	4,151	3,577	3,157	3,300
Iron	+1.2	+3.4	9,642	10,795	12.177	14,609
Kane	+0.3	+6.3	2,299	2,667	2,421	3,384
Washington	+1.7	+5.3	9,836	10,271	13,669	18,127
SWMCD Total	---	---	30,784	31,641	35,224	43,506
SWMCD	+0.7	+3.9	---	---	---	---
Utah	+2.2	+2.4	688,862	890,627	1,059,273	1,207,000

Sources: U.S. Bureau of the Census, Census of Population, 1950-1970, Utah: Number of Inhabitants (Washington, D.C.: U.S. Government Printing Office).

U.S. Bureau of the Census, Current Population Reports, Population Estimates and Projections, Series p-25, No. 692 (Washington, D.C.: U.S.Government Printing Office, April, 1977).

Examination of the components of population change is especially useful since it illustrates the close relation between the regional or local economy and changes in population. Table II-18 shows that net migration, which is related to local economic conditions, is an important determinant of the net change in population. Though the region experienced a large natural increase in population between 1950 and 1960, sizeable out-migration occurred and the net result was a very small increase in total population. During the next ten years, net out-migration declined in importance as a component of population change, except in Kane County, which experienced an increase in net out-migration. Thus, the slow population growth seen in the region during the 1950-70 period was a consequence of net out-migration. Net in-migration did occur in Washington County during the 1960-70 period, but that was due in large part to a movement of retired persons into the county.

Although the region's population was younger than the rest of the state in 1950, the 20-year period of slow population growth significantly changed the age composition of the population. In 1970, about 10.2 percent of the population was 65 years of age and over. The corresponding state figure was 8.6 percent. Decreases in the percent of the population 20-44 years of age (an important component of regional labor supply) also occurred. For the state, 31.6 percent of the population was in this age group; for the region, 27.1 percent. Garfield and Kane Counties have still lower percentages of the population who are 20-44 years of age. Table II-19 compares population age group composition in the region and in Utah.

Growth in the region's nine major communities (see table II-20) has been substantially the same as that for the counties in which they are found, and in most instances community population growth was the major factor affecting county growth rates. The rapid growth of the only ruban areas in the region, Cedar City and St. George, has determined the urban/rural population mix of the entire region.

b. Regional Economic Characteristics

Examination of an area's economic base (those industrial sectors which produce goods and services for markets located outside the area being studied) is essential in order to determine probable future conditions in the economy and, from this, to estimate future characteristics of the area's population. Basic industrial sectors are a determining force within the local economy. Circumstances of sector growth or decline can be illustrated by the use of county employment and income data.

c. Employment

Sectors which generate most regional employment are government, trade, agriculture, services, manufacturing, transportation, communication, and public utilities. The importance of each sector in each county varies considerably, as shown in table II-21.

Table II-18.--The components of population change: Natural increase vs. net migration

[Sources: U.S. Bureau of Census, Current Population Reports, Series P-23, No. 7; and Series P-25, No. 461 (Washington, D.C.: U.S. Government Printing Office)]

	Components of Change 1950-1960				Components of Change 1960-1970			
	Net Change	Natural Increase	Net Migration	Percentage Change	Net Change	Natural Increase	Net Migration	Percentage Change
Southwestern Study Group--------	875	7,088	-6,231	2.8	3,583	4,717	-1,134	11.3
Beaver----------	-524	955	-1,480	-10.8	-531	406	-937	-12.3
Garfield--------	-574	766	-1,340	-13.8	-420	375	-795	-11.7
Iron------------	1,153	2,544	-1,391	12.0	1,382	1,766	-384	12.8
Kane------------	368	601	-233	16.0	-246	488	-694	9.2
Washington------	435	2,222	-1,787	4.4	3,398	1,722	1,676	33.1

Table II-19.--Population of the United States, Utah and the Southwestern counties by age distribution (Percentage breakdown, 1970)

	Under 5	5-14	15-19	20-24	25-44	45-64	65-older	Total
Southwestern	3,482	7,096	4,497	2,833	6,738	6,408	3,602	36,224
	9.9	21.8	12.8	8.0	19.0	18.3	10.2	100.0
Beaver	319	820	400	196	731	1,120	440	3,800
	8.4	21.6	10.5	5.2	19.2	23.5	11.6	100.0
Garfield	258	880	355	139	631	685	309	3,157
	8.2	24.7	11.2	4.4	20.0	21.7	9.8	100.0
Iron	1,273	2,441	1,661	1,433	2,446	1,994	929	12,177
	10.5	20.0	13.6	11.8	20.1	16.3	7.7	100.0
Kane	244	569	233	98	498	538	241	2,421
	10.1	23.5	9.6	4.0	20.6	22.2	10.0	100.0
Washington	1,388	3,054	1,848	967	2,432	2,297	1,683	13,669
	10.2	22.4	13.5	7.1	17.8	16.7	12.3	100.0
Utah	111,798	240,253	116,607	97,059	237,519	177,188	77,561	1,059,273
	10.5	22.8	11.0	9.2	22.4	16.8	8.6	100.0
United States	8.4	20.0	9.4	8.1	23.6	20.6	9.9	100.0

Sources: U.S. Bureau of the Census, Census of Population: 1960-1970, Utah: General Population Characteristics; and U.S. Summary: General Population Characteristics (Washington, D.C.: U.S. Government Printing Office)

Table II-20.--Total population selected communities in the southwestern counties

Community	1950	1960	1970	1975
Beaver	1,685	1,548	1,453	1,750
Cedar City	6,106	7,543	8,946	10,349
Escalante	773	702	638	652
Hurricane	1,271	1,251	1,408	1,725
Kanab	1,287	1,645	1,381	2,088
Milford	1,673	1,471	1,304	1,283
Panguitch	1,501	1,435	1,318	1,314
Parowan	1,455	1,486	1,423	1,764
St. George	4,562	5,130	7,097	8,760

Sources: U.S. Bureau of the Census, Census of Population, 1950-1970, Utah: Number of Inhabitants (Washington, D.C.: U.S. Government Printing Office).

U.S. Bureau of the Census, Current Population Reports, Population Estimates and Projections, Series P-25, No. 692 (Washington, D.C.: U.S. Government Printing Office, April, 1977).

Table II-21.--Percentage of 1975 employment in four largest employment sectors in the southwestern counties 1/

Sector	Beaver	Garfield	Iron	Kane	Washington	SWMCD
Government	18.8	25.6	25.5	27.6	22.5	23.9
Farm	17.3	16.7	9.9	15.2	8.4	11.2
Trade	17.4		23.0	21.0	26.7	22.2
Services		14.1		11.7	11.5	
Manufacturing		14.7	5.9			
Transportation, Communication, Public Util.	9.3					

1/ Some information has been suppressed to preserve confidentiality.

Source: U.S. Department of Commerce, Burau of Economic Analysis tapes.

The regional economy differs significantly from that of Utah and the nation. The farm sector, for example, employs 2.5 times more workers in the region than is the case nationally (though the state's farm sector is less important to its economy than the farm sector is nationally). The government sector is a relatively more important employer in the region than it is in the nation, though large State and local government employment is the main reason for this. Manufacturing is, relatively, a very small employer in the region, as are such sectors as services, and finance, insurance, and real estate. For reasons of efficiency these sectors tend to be concentrated in higher order urban and regional centers.

Table II-22 shows the composition of employment by sector. A comparison through time (1950-1975) will indicate the changing relative importance to the regional economy of each sector. Table II-23 contains employment information for Garfield County, and Table II-24 the same for Kane County. What should be noticed is the extremely small size of the employment sectors in the two counties.

In Garfield, government employment increased from 1950 to 1967, but has been constant since. Farm employment has decreased by 45 percent during the period, trade has been constant throughout the period, and manufacturing and services have grown.

Farm employment has declined in Kane County also (a 24 percent decrease). Service employment has declined and trade has been quite constant. Government is the only sector to sustain positive growth during the 25-year period, principally due to growth in State and local government employment. (The Federal employment component of the government sector is relatively more important in Garfield than in Kane.)

d. Sources of Income

The pattern of employment and the sources of personal income in an economy are closely related. But income derives not only from employment (wage and salary income) but also from transfer payments and property incomes (dividends, rents, and interest payments). Thus, employment and income should be viewed separately to gain a complete picture of the regional economy. Table II-25 shows sources of personal income. Note that considerable variation exists. Net earnings are a less important component of personal income regionally than nationally, meaning the region is typical of areas having below average income levels. It is consistent with other regional economic characteristics that property income and transfer payments are larger shares of personal income in the region than in the state or nation. This income pattern derives in part from a high ratio of nonworking to working residents, a larger than typical portion of the population either young or old, an occupational mix offering few high-paying jobs, and a high unemployment rate.

Table II-22 --Employment by type and broad industrial sector in the southwestern counties

[Sources: 1950 and 1960 data were obtained from Census of the Population, Vol. 2: Characteristics of the Population, Utah. The census data were aggregated according to the 1967 Standard Industrial Classification Manual (Washington, D.C.: Office of Statistical Standards). 1970 and 1975 data were aggregated on the basis of county data from the Bureau of Economic Analysis tapes. D, suppressed to prevent disclosure of confidential data]

Employment categories	1950 Number	1950 Percent	1960 Number	1960 Percent	1970 Number	1970 Percent	1975 Number	1975 Percent
Non-farm:								
Private:								
Manufacturing--	376	4.0	637	6.2	D	----	D	----
Mining---------	465	4.9	643	6.2	D	----	D	----
Construction---	724	7.7	832	8.0	561	4.2	688	4.3
Transportation, communications and public utilities-----	891	9.4	833	8.1	D	----	D	----
Trade----------	1,512	16.0	2,220	21.5	2,560	19.0	3,534	22.2
Finance--------	116	1.2	158	1.5	D	----	444	2.8
Services-------	1,185	12.5	1,700	16.4	1,516	11.3	D	----
Other----------	221	2.3	176	1.7	D	----	52	.3
Subtotal---	5,490	58.0	7,199	69.6	6,710	49.8	8,535	53.6
Government-------	1,064	11.2	1,302	12.6	3,276	24.3	3,811	23.9
Total non-farm--	6,554	69.2	8,501	82.2	11,642	86.4	14,134	88.8
Farm---------------	2,907	30.7	1,839	17.8	1,831	13.6	1,791	11.2
Total employment	9,461	99.9	10,340	100.0	13,473	100.0	15,925	100.0

Table II-23.--Employment by type and broad industrial sector in Garfield County, 1950-1975

	1950	1960	1970	1975
Total Employment	1137	1185	1496	1579
Total Farm	476	242	442	264
Total Non-Farm	661	943	1222	1315
Number of Proprietors			390	384
Farm			222	204
Non-Farm			168	180
Wage and Salary			1106	1195
Farm			52	60
Non-Farm			1054	1135
Government	126	202	389	405
Total Federal			108	122
Federal Civilian			108	122
Military			—	—
State and Local			281	283
Private Non-Farm	535	741	665	730
Manufacturing	60	182	(D)	232
Mining	8	61	(D)	39
Construction	105	102	36	24
TCU[a]	48	17	(D)	49
Trade	146	212	130	150
Fin.,Ins.,Real Estate	4	12	(D)	14
Services	126	144	223	222
Other	38	11	(D)	—

[a]Transportation, Communications and Utilities.

[b]Finance, Insurance and Real Estate.

(D) Suppressed to prevent disclosure of confidential data.

Source: Bureau of Economic Analysis tapes.

Table II-24.--Employment by type and broad industrial sector in Kane County, 1950-75

[Source: Bureau of Economic Analysis tapes]

	1950	1960	1970	1975
Total Employment	696	848	1,000	1,159
Total Farm	232	129	183	176
Total Non-Farm	464	719	815	983
Number of Proprietors	---	---	285	284
Farm	---	---	148	136
Non-Farm	---	---	137	148
Wage and Salary	---	---	715	875
Farm	---	---	35	40
Non-Farm	---	---	680	835
Government	78	111	240	320
Total Federal	---	---	42	44
Federal Civilian	---	---	42	44
Military	---	---	0	0
State and Local	---	---	198	276
Private Non-Farm	386	608	440	515
Manufacturing	57	128	([3])	([3])
Mining	2	0	([3])	([3])
Construction	80	99	17	23
TCU[1]	34	9	([3])	([3])
Trade	95	197	180	243
FIR[2]	0	12	11	31
Services	101	155	148	136
Other	17	8	([3])	0

[1] Transportation, Comunications and Utilities.
[2] Finance, Insurance and Real Estate.
[3] Suppressed to prevent disclosure of confidential data.

Table II-25.--Personal income in southern counties by source

[Sources: U.S. Department of Commerce, Bureau of Economic Analysis, Regional Economic Information System file. For the 1975, U.S. figure, see U.S. Department of Commerce Commerce, "Personal income by major sources, 1973-76," Survey of current business, Vol. 57, No. 8 (August, 1977). Top entry is in thousands of dollars, bottom entry is in percent of total, 1975]

	U.S.	Utah	Beaver	Garfield	Iron	Kane	Washington
Net earnings[1]-	$899,350,000	$4,377,856	$11,775	$7,890	$43,625	$7,739	$38,299
	72.1	73.5	64.7	64.2	71.1	66.2	57.8
Property income-------	$170,318,000	$860,616	$2,877	$2,037	$10,004	$2,041	$15,381
	13.7	14.5	15.8	16.6	16.3	17.4	23.3
Transfer payments-----	$176,833,000	$715,909	$3,545	$2,354	$7,730	$1,918	$12,529
	14.2	12.0	19.5	19.2	12.6	16.4	18.9
Total personal income---	$1,246,501,000	$5,954,381	$18,197	$12,281	$61,359	$11,698	$66,139
	100.0	100.0	100.0	100.0	100.0	100.0	100.0

[1]Labor and proprietors' income less personal contributions for social insurance by place of residence.

Table II-26 traces the growth path of total personal income in the region by county. Table II-27 converts this information to a per capita basis and allows a ready comparison with the State. The region's most populous counties, Washington and Iron, account for the bulk of its total personal income. The small size of Garfield and Kane are apparent in table II-26. Since 1950, per capita personal income in the counties has been below that of the State.

The percentage breakdown in table II-28 allows a comparison of sources of earnings between Utah, the region, and the U.S., in 1975. The percentage of earnings generated in the farming sector in Utah (2.1 percent) is considerably lower than in the nation (3.0 percent). In 1975 Beaver County was the most farm-oriented county in the region (20.8 percent). The large amount of earnings that are generated in the manufacturing sector in Garfield County is unusual among the region's counties. Table II-28 also suggests that the region is particularly reliant on tourism which generates a relatively large percentage of activity in the trade sector; and on state and local government, which though not a large sector in absolute terms is large in relation to the region's generally depressed economy.

In summary, the regional economy is significantly different from that of the state and the nation. Substantial diversity exists among the five counties themselves. The farm sector is very important in this region. Its contribution has been relatively greater than the national average in each county during the 1970s. Although the farm sector is the second and third largest employment sector in Garfield and Kane Counties, in 1975 its contribution to total personal income was negligible. The trade and government sectors, on the other hand, contribute more to total personal income than they do to total employment in Garfield and Kane Counties. Services also account for a greater share of total personal income than of total employment in Kane County, but that is not the case in Garfield County.

e. Unemployment and Poverty Levels

Where unemployment rates are high and a relatively large proportion of economic activity results from tourism and recreation, one expects to find evidence of seasonal employment patterns. Such patterns are encountered in the southwestern counties. The two least populated counties in the region--Garfield and Kane--have had the highest rates of unemployment historically, although the picture has improved markedly in Kane County since 1970 (see table II-29). It is significant that this reduction in Kane County occurred at a time when population increased by almost 1,000 persons. Garfield and Kane have had wide variations in unemployment rates. Rural areas having limited economies are frequently susceptible to undesirable fluctuations in economic activity. Lack of diversity in the employment base helps explain this.

Data indicating poverty conditions in the region is shown for 1970 on table II-30.

Table II-26.--Total personal income in southwestern counties residence adjusted (thousands of dollars)

	1950	1959	1965	1970	1971	1972	1973	1974	1975
Utah	$911,500	$1,675,400	$2,368,800	$3,439,462	$3,760,483	$4,216,337	$4,814,051	$5,349,770	$5,954,381
Southwestern Counties									
Beaver	5,900	6,000	8,300	10,384	11,821	13,067	15,669	17,409	18,197
Garfield	3,800	5,400	5,900	7,551	8,664	9,585	10,685	11,156	12,281
Iron	10,300	18,600	25,100	33,599	38,567	43,028	49,824	55,155	61,359
Kane	2,400	4,600	4,600	6,478	7,611	9,268	10,363	10,828	11,698
Washington	8,300	15,500	21,500	34,911	38,203	44,400	53,843	58,667	66,139

Source: 1970-75 U.S. Department of Commerce, Bureau of Economic Analysis, Local Area Personal Income 1970-1975, Vol.8.; 1950, 1959, 1965 Bureau of Economic Analysis Tapes.

Table II-27..--Per capita personal income in southwestern counties residence adjusted

[Source: 1970-75, U.S. Department of Commerce, Bureau of Economic Analysis, Local Area Personal Income 1970-1975, v. 8; 1950, 1959, 1965, BEA Tapes]

	1950	1959	1965	1970	1971	1972	1973	1974	1975
Utah	$1,310	$1,926	$2,390	$3,227	$3,437	$3,740	$4,185	$4,539	$4,938
Southwestern Counties									
Beaver	1,206	1,424	2,021	2,697	3,112	3,351	3,913	4,347	4,459
Garfield	918	1,533	1,746	2,397	2,709	2,995	3,386	3,316	3,785
Iron	1,054	1,764	2,348	2,732	2,991	3,235	3,632	3,895	4,134
Kane	1,023	1,782	1,760	2,644	3,046	3,196	3,325	3,294	3,527
Washington	834	1,544	2,030	2,512	2,565	2.902	3.366	3,330	3,663

Table II-28.--Earnings by industrial source as a percentage of total earnings in southwestern counties, 1975

[Source: U.S. Department of Commerce, Bureau of Economic Analysis, Regional Economic Information System File. 1975 U.S. Figures: U.S. Department of Commerce, "Personal Income by Major Sources, 1973-76", Vol. 57, No.8 (August 1977)]

Source/Type Earnings[1]	U.S.	Utah	Beaver	Garfield	Iron	Kane	Washington
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Farm	3.0	2.1	20.8	-1.2	9.7	0.9	6.9
Manufacturing	25.2	16.9	4.0	21.2	6.3	([4])	7.9
Mining	1.4	4.5	3.2	6.9	([4])	([4])	-0.1
Construction	5.8	7.1	4.1	4.0	6.1	6.0	9.2
Trade	17.0	17.8	14.5	11.8	19.9	25.7	27.4
FIR[2]	5.2	4.4	3.3	1.0	3.2	3.5	3.3
TCU[3]	7.4	8.4	21.2	6.8	6.5	([4])	4.4
Services	16.4	14.0	7.4	11.4	([4])	17.3	14.0
Federal Government, Civilian	4.4	11.1	4.2	13.5	6.9	10.2	5.0
Military	1.9	1.5	0.6	0.7	1.3	1.1	2.1
State and Local Government	11.9	11.9	15.8	23.0	19.5	25.1	18.3
Other	0.4	0.3	0.7	1.0	0.5	0.0	1.6

[1] Labor and proprietor's income by place of work. Detail may not add to total due to rounding.
[2] Finance, Insurance and Real Estate.
[3] Transportation, Communications and Public Utilities.
[4] Not shown to avoid disclosure of individual company information.

Table II-29.--Unemployment rates in the southwestern Counties
1950-1976 (by percent)

Year	U.S.	Utah	Beaver	Garfield	Iron	Kane	Washington	Year	U.S.	Utah	Beaver	Garfield	Iron	Kane	Washington
1950	5.3	--	8.6	20.1	5.9	17.1	8.6	1964	5.2	6.0	9.3	13.3	5.7	10.9	6.1
1951	3.3	3.3	5.6	17.6	3.4	13.5	4.7	1965	4.5	6.9	6.9	10.8	3.6	7.5	4.1
1952	3.0	3.2	8.9	15.9	4.2	18.3	5.9	1966	3.8	4.1	6.6	14.2	4.2	10.4	4.9
1953	2.9	3.3	9.4	17.7	3.7	14.4	5.4	1967	3.8	5.2	4.9	14.4	4.6	13.7	5.9
1954	5.5	5.2	9.4	14.1	6.0	12.8	5.2	1968	3.6	5.4	4.1	17.2	4.7	14.4	5.6
1955	4.4	4.1	6.8	15.1	4.8	11.7	5.9	1969	3.5	5.2	5.4	16.5	4.1	13.6	5.4
1956	4.1	3.4	9.2	14.7	4.0	11.3	5.6	1970	4.9	6.1	5.5	21.3	4.6	15.3	5.5
1957	4.3	3.7	8.5	14.7	4.1	7.9	5.7	1971	5.9	6.6	6.4	22.9	4.1	12.8	5.8
1958	6.8	5.3	10.1	13.5	4.6	8.2	4.7	1972	5.6	6.3	6.1	19.3	5.7	11.6	5.5
1959	5.5	4.6	8.5	12.7	4.8	7.3	6.1	1973	4.9	5.8	6.0	14.6	5.6	7.3	4.9
1960	5.6	4.8	8.3	14.6	4.3	6.0	6.1	1974	5.6	6.1	6.4	15.4	5.6	7.1	5.0
1961	6.7	5.3	9.4	15.1	5.1	6.4	5.4	1975	8.5	7.4	8.5	15.0	6.9	7.8	7.7
1962	5.5	4.9	8.3	13.8	3.6	6.4	5.4	1976	7.7	5.2	6.1	12.3	6.6	6.0	5.6
1963	5.7	5.4	7.5	13.4	4.2	6.5	5.4								

Source: For county information for 1950-1973 see Utah Labor Market Information, Utah Department of Employment Security, Employment Newsletter, 3/77; for 1974-1976 see Utah Industrial Development Information System, Utah, County Economic Facts 1975, 1976, 1977 editions. For state information see Utah Department of Employment Security Annual Report 1974 and Annual Report 1977. For U.S. unemployment rates see U.S. Department of Labor, Report on Employment and Training Requirements, Resources, and Utilization, 1977.

Table II-30.--Incomes less than poverty level, southwestern counties, 1970
[Source: 1970 Census: Utah Detail Chart]

	Beaver	Garfield	Iron	Kane	Washington
Families	202	101	288	46	488
Percent of all families	19.4	12.3	9.9	7.5	15.2
Mean family income	$1,648	$2,244	$1,942	$3,243	$1,875
Percent receiving public assistance	11.4	22.8	13.2	17.4	10.2
Unrelated individuals	128	69	504	73	496
Percent of all unrelated individuals	55.4	52.7	58.1	67.6	61.5
Mean income	$854	$869	$978	$884	$814
Percent receiving public assistance	6.3	13.0	6.2	6.8	10.3
Persons	718	507	1,537	299	2,488
Percent of all persons	19.0	16.1	13.1	12.4	18.8
Percent receiving Social Security	32.2	13.0	17.8	30.8	20.4
Percent 65 years and over	32.2	14.0	16.7	32.4	19.6
Percent receiving Social Security	83.0	77.5	84.8	88.7	78.0

f. Community Trading Relationships

A community's population is only partially suggestive of its relative economic importance. Communities can be ranked on the basis of the economic functions present in each. Such a ranking is given for the region's communities in table II-31. Residents of smaller (lower ranked) communities spend portions of their incomes in higher ranked communities. As all communities in the region are relatively small, even the largest of them cannot provide the full range of goods and services residents may demand, so in varying proportions all are dependent on the State's largest cities.

Even though the region is far from the concentration of population and economic activity on the Wasatch Front, it is considered to be in the Salt Lake City trading area. Although Las Vegas undoubtedly attracts some of the region's purchasing power as well, no data exist to show the size of the flows to these two retailing centers.

Cedar City is a regional center attracting an estimated $16 million in retail sales and services in 1972 from surrounding communities that lie within its trading area. St. George, though of less importance in this sense than Cedar City, attracted about $12.5 million in retail sales and services in that same year. Table II-31 lists service center classifications, current population, current per capita retail sales, and money income per capita for selected communities within the region.

Some communities, notably Panguitch and Escalante, have a retailing importance which is more than would be predicted on the basis of their populations alone. Washington and Parowan, on the other hand, because of their proximity to the large retailing centers, exhibit a retailing dependence upon their larger neighbors.

g. Municipal Services

Kane and Garfield Counties are of principal concern within the region. They contain small rural communities having limited abilities to provide municipal services. Existing services and facilities provided in Garfield and Kane Counties have been viewed in terms of the current level of services provided, the adequacy of services in meeting community needs, and the current ability to serve more people. It is difficult to judge how well community needs are fulfilled currently, since services provided reflect the particular preferences of a community and cannot be compared to any well-established and accepted standards. In many cases the "output" of a service is not directly measurable, as for example, police protection. In such cases the judgments of local community officials as to adequacy of service delivery are relied upon.

Table II-31.--Service center classifications, current population per capita retail sales, and money income per capita for selected communities

Community	Service Center Ranking [a]	1975 Population	1975 Per Capita Retail Sales	1974 Money Income Per Capita
Cedar City	Regional	10,349	$4,794	$3,553
St. George	Community	8,760	5,580	3,745
Kanab	Full	2,088	2,643	4,140
Parowan	Partial	1,764	1,002	3,124
Beaver	Full	1,750	2,757	2,823
Hurricane	Full	1,725	2,826	3,016
Panguitch	Full	1,314	3,785	4,529
Milford	Full	1,283	1,616	4,863
Washington	Hamlet	1,245	787	2,451
Escalante	Partial	652	1,687	4,113

[a] Service Centers were defined (see below) on the basis of economic functions available, as of 1975, in each community. Each higher order service center must meet all of the criteria of service centers ranked below it.

Hamlet--Both a population of 50 and a post office are required.

Partial Convenience Center--Two of three required: bank, high school, or mortuary.

Full Convenience Center--Three of four required: daily or weekly newspaper, medical doctor, new car dealer, or public library.

Community Service Center--Retail sales of at least $16 million plus two of three required: hospital, radio station, or airport with hard surface.

Regional Service Center--Retail sales of at least $40 million plus two of three required: public higher education, daily newspaper, or scheduled air passenger service.

Metropolitan Service Center--Retail sales of at least $160 million.

National Service Center--Retail sales of at least $1.6 billion.

Source: Supplementary material on community hierarchies available in an unpublished report prepared for the Utah State Planning Coordinator's Office by the Bureau of Economic and Business Research, University of Utah.

Generally the level of services provided by the communities of principal concern are similar because all are small in size and have limited financial resources. Seven of the 12 towns have a population of less than 200, and two of the others less than 500. Residents in communities with population less than 500 relate to their community in quite different ways than do residents of large urban areas. In the small communities much work is done for the community on a volunteer basis, and governmental functions are often handled by locally elected people who receive little or no financial compensation. As the town grows and the business of operating it becomes more complex and time consuming, this arrangement may not be adequate. The ability to provide services to a large number of additional people does not exist within this type of organization. These small communities more closely resemble neighborhoods than cities. The capital investment in facilities such as water and sewage disposal systems has generally been limited to that which would be necessary to serve relatively stable population.

The following categories, Police and Fire Protection, Libraries and Parks, Streets and Roads, and Waste Disposal and Water Supply, summarize the existing level of services provided by the communities.

Police and Fire Protection

The level of fire protection services provided by the communities varies widely. Several of the communities have neither organized fire department nor equipment. These towns are dependent on volunteers and use equipment from other towns or the Forest Service. In the larger communities active volunteer fire departments serve the town needs. However, adequate equipment is still a problem because of the equipment costs.

The level of police services a community accepts is dependent on the types and magnitude of its problems. Most of the communities rely on the county sheriff's office or have part-time town marshalls. This level of service is usually adequate for meeting the needs of small, remote communities.

Libraries and Parks

Library services are provided to residents by the State bookmobile system in all the communities. The population required to adequately support a library far exceeds the size of most of them. Exceptions are Kanab and Panguitch, each having a town library.

Only limited park development exists in most of the communities (again, Panguitch and Kanab are exceptions), although several communities are in the process of improving park facilities. For the small communities, maintenance costs are offset by volunteer help.

Streets and Roads

Street maintenance is very limited in most of the towns. The smaller communities generally do not own any equipment, and often rent it from the county. In Alton, street maintenance is done on a volunteer basis. Panguitch and Kanab own their own equipment, however.

Waste Disposal and Water Supply

Solid waste disposal is handled by the county in Garfield, except for the towns of Antimony, Boulder and Escalante. In Kane County, each community has access to a dump. None meets the State Division of Health standards. A community-wide system in Kane County has been discussed, but no specific plans have been made.

In all the towns except Tropic and Kanab, septic tanks are used for sewage disposal. In Garfield County, septic tanks provide an acceptable method of wastewater disposal. In Kane County, however, soil conditions are such that the communities are having problems with the use of septic tanks. Improvements planned by the Long Valley Sewer Improvement District should soon solve problems for Glendale, Orderville and Mount Carmel. Kanab is presently planning a lagoon system.

Based on an assessment of water supply, storage capacities, and distribution systems, Alton and Kanab are the only communities having less than adequate culinary water systems. Both, however, plan to upgrade their systems in 1978. All of the other communities have excess capacity.

h. County Services

Counties provide a number of services. Both Kane and Garfield Counties maintain administrative offices in the County Court House and facilities are adequate for current demands. Both counties have a sheriff's department which provides police services to communities as well as to the unincorporated areas. Both sheriffs' departments have an adequate staff and necessary equipment, including jail facilities. In Garfield County, it is proposed to expand the jailing facility. If approved, construction would begin in 1978. The counties have responsibility for maintenance of all county roads and are adequately fulfilling that responsibility. Solid waste disposal is the responsibility of the county in the rural areas. The State Division of Health has specific standards for required landfill operations. In order to make such an operation economically feasible, county-wide coverage is usually required. Garfield County has such a system, serving all but three towns. Kane County has plans for such an operation but has had problems in securing an acceptable site. Kane and Garfield operate county hospitals in Kanab and Panguitch. The hospitals and the physicians associated with them are the primary source of health care services. Both hospitals provide long-term care as well as acute care facilities.

Glendale is regularly served by one of the physicians from Kanab through a program that sets up a temporary office of the physician.

i. Financing

The financing of services provided by the communities and by the counties are usually covered by funds from taxes, State and Federal fund transfers, and fees and fines collected. Because daily operation and maintenance costs are covered by these sources the level of services provided is limited by the availability of such funds. Generally the most important source of funds is property tax revenues. For large capital investment improvements the communities must turn to State and Federal grants and to borrowing through the issuance of bonds. The ability of a community to issue general obligation bonds is limited to a percentage of its total assessed valuation. The importance of the financial structure of the local levels of government will be more fully discussed in chapter IV.

j. Education

Four schools, Valley Elementary, Valley High, Kanab Elementary, and Kanab High are located in the Kane County School District. The total enrollment in these four schools was 859 at the close of the 1975-76 school year. The district staff consisted of 1 superintendent, 1 clerk, 1 secondary counselor, 1 full-time secondary principal, 3 teaching principals, 35 teachers (full-time equivalent, FTE), 5 secretaries, 5 custodians, and 6 1/2 school lunch workers (FTE).

All schools are relatively new with the exception of parts of the two high schools, which have some older sections that have been remodeled. The Superintendent reports that the Kanab schools are being utilized almost to capacity, with the Valley schools able to absorb moderate growth. There is the possibility of expanding the existing schools in Orderville but not at Kanab.

The current budget for Kane County School District is $1,830,299. The mill levy is 43.15. The estimated assessed valuation is over $9 million, yielding a total bonding capacity of approximately $1,200,000. At present, the district has $275,000 outstanding bonds due to be retired by 1986.

Six schools, Panguitch Elementary, Panguitch High, Bryce Valley school, Antimony School, Escalante Elementary, and Escalante High are located in the county. The total enrollment was 832 (Antimony secondary students are bused to nearby Piute High) at the close of 1976-77 school year. The district personnel consisted of 1 superintendent, 1 clerk, 1 curriculum director, 1 counselor, 1 maintenance supervisor, 4 1/2 principals (FTE), 40 teachers (FTE), 4 secretaries, 3 teachers aides, 6 school lunch workers, and 5 custodians (FTE).

District personnel report that only the Panguitch Elementary School is currently near capacity. Existing schools could be expanded.

The current budget for Garfield County School District is $1,650,661. The mill levy is 39.00. The estimated assessed valuation is over $14 million, yielding a total bonding capacity of approximately $1,862,000. At present, the district has $290,000 in outstanding bonds due to be retired by 1982.

k. Housing and Utilities

The housing situation in all the communities is relatively stable. There is a predominance of single-family homes. Few vacancies exist. In several of the Garfield County towns mobile homes account for a signficant proportion of all dwelling units. This is not true in Kane County and there are no mobile home parks established in the county. The development of new residential areas in Kane County will be controlled by uniform codes and ordinances (adopted April, 1978) covering the communities of Kanab, Orderville, and Glendale, and Kane County itself. Garfield County adopted a subdivision ordinance in 1966. There are no similar ordinances or codes in the communities there.

Utility services are provided to Kane and Garfield County residents by three electric power companies, two telephone companies, eight fuel oil companies and two liquified gas companies. These companies are adequately meeting the demand for utility services.

5. TRANSPORTATION

A map of highways in southern Utah is shown as figure II-19.

There are only two major through highways, I-15 extending northeastward through St. George and Cedar City, and U.S. Highway 89, entering Utah near Page, Ariz., continuing generally westward to Kanab, then northward through Panguitch and Richfield. Both highways pass through Salt Lake City (off the map). The rest of the area is served by secondary feeder routes.

The proposed Warner Valley power plant can be reached by partly improved roads south out of Hurricane. Access to Hurricane from the north and southwest is via I-15 and U-15. Access from the east over U-15 is restricted by passage through Zion National Park, which includes steep grades, sharp curves, and particularly a tunnel, which tends to slow traffic. Access from the southeast, through Fredonia over A-389 and U-59, is relatively unrestricted, although the road is not heavy-duty.

Access to the Alton Coal Field from the north, west, and south is via U.S. Highway 89, a two-lane, medium-duty road carrying 1,020 vehicles per day at the mouth of Johnson Canyon and 1,650 vehicles per day at the Alton Junction in 1975. Direct access to the coal field is

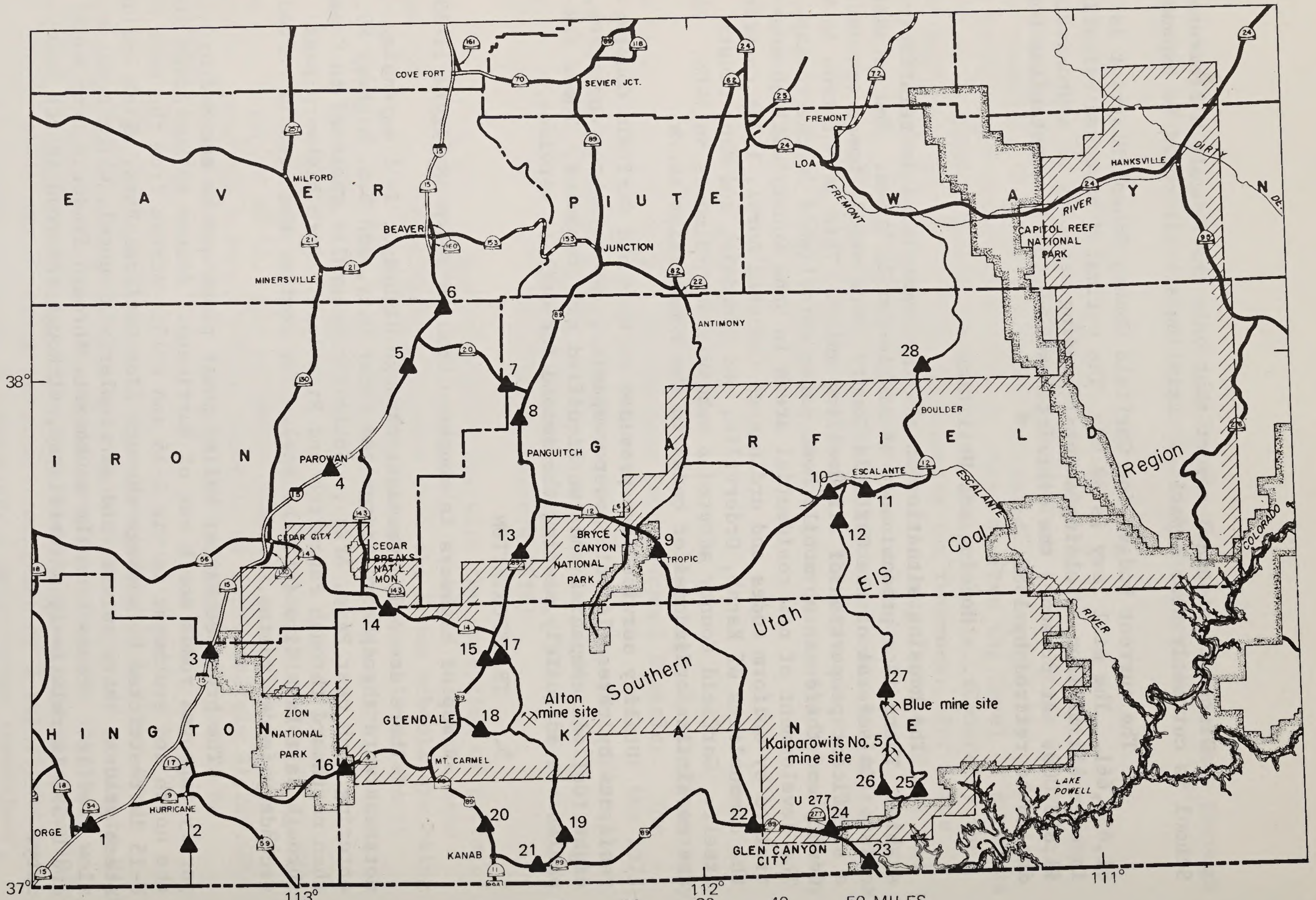


Figure II-19.--Southern Utah state highway network.

by a partly asphalted and improved road through Alton from the north, an improved county road from Glendale on the east, and a partly asphalted and improved road from U.S. Highway 89 9 miles east of Kanab northward through Johnson Canyon. Access may be had through a partly improved county road southward and westward from U-12 at Cannonville.

Highway access to the Kaiparowits Plateau is from U.S. Highway 89 at Glen Canyon City on the south, and U-12 at Escalante on the north, the latter a feeder highway with restricted outlet to the east. One graded road connects U.S. Highway 89 at Glen Canyon City to U-12 at Escalante and crosses the Plateau. Between U.S. Highway 89 and the boundary of the Glen Canyon NRA, this road is a part of the state highway system U-277. It has 26 feet of road surface and is built on a 50-foot right-of-way. Within the NRA the road narrows and is maintained as is by Kane County. Built on public lands before the creation of the NRA, this part of the road has no formal right-of-way. The Park Service and BLM recognize a prescriptive right-of-way and use. Any improvements beyond the present road prism, however, must be approved by BLM and NPS. There are many other unimproved to graded roads on the plateau, all connecting to this one spinal road.

Access to the Hanksville area in the northeast part of the region is by U-24. West of Hanksville U-24 passes through Capitol Reef National Park, where traffic bottlenecks due to sharp curves and narrow road. It is the only major access to the park, carries 320 to 450 vehicles per day, and the Park Service retains ownership of the road and right-of-way through the park.

Access to the west side of the Henry Mountains is south from U-24 on the Notom Road, a graded and partly drained and maintained county road leading southward along the east edge of Capitol Reef National Park.

No railroads presently approach the region.

To the north in the Central Utah coal region, the Denver & Rio Grande Western Railroad enters from Colorado, passes through Green River and Price, crosses to Spanish Fork, and Provo. From this main line, a spur line extends southward through the Sevier River Valley through Richfield to Marysvale. No traffic uses the Richfield-to-Marysvale leg; it would have to be substantially upgraded to handle large coal traffic.

West of the region the Union Pacific Railroad passes southwestward from Provo through Delta and Milford, Lund, Beryl, and Modena, on its way to Las Vegas. From the UP a spur goes eastward to Cedar City.

South of the region the Atcheson, Topeka, and Sante Fe Railroad crosses east to west through central Arizona and Flagstaff. There are no railroad bridges across the Colorado River in northern Arizona.

Present, presently committed, and 1995 proposed transmission lines are shown on the map, figure II-20. Of most importance to Kaiparowits Plateau coal development is a 230 kV line from the Navajo Power Plant near Page, Ariz. to the Sigurd substation of Utah Power & Light Company. The line passes on the south and west sides of the Plateau.

The Alton coal field is within the GarKane Power Association, Inc., service area. It is understood that no power utility has been given the Kaiparowits Plateau service area; there is no power there now. There is also no power at the Henry Mountains coal field.

The smaller towns and communities are served through the local distribution systems of GarKane or Utah Power & Light.

Telephone service is available to all communities, either through the Mountain Bell System or through local telephone companies.

There is no natural gas service to the mining areas.

6. RECREATION

Figure II-21 outlines the area (hereinafter called the Southern Utah Coal Region Recreation Influence Zone or RIZ) where primary and secondary impacts would accrue to the recreation resource as a result of mining 12 mty of coal. Figure II-21 also shows the general location of the proposed coal development addressed in part II of this document. Developed public (Federal and State) recreation sites, primary travel routes, and principal population areas, within and adjacent to the region, are also shown.

The RIZ is based on recreation use within the region. Travel times from communities to recreation areas within the region range from less than 1 to as much as 3 hours. Areas within 2 hours travel time not included within the RIZ either lack recreation attractions and are lightly used for recreation, or have the user carrying capacity to accommodate projected increases of use without impairment of resource or individual user values. Areas within the RIZ that would require more than 2 hours travel time possess significant recreation attractions but generally lack enough developed facilities or have administrative restraints on types of use.

Because of the low population density, land ownership, and lack of other significant industrial development within the region, nearly all of the area is available for outdoor recreation use.

Table II-32 outlines the major local, regional and national recreation attractions and use areas within the RIZ. These attractions create the number one industry in southern Utah and northern Arizona, which is recreation and tourism combined.

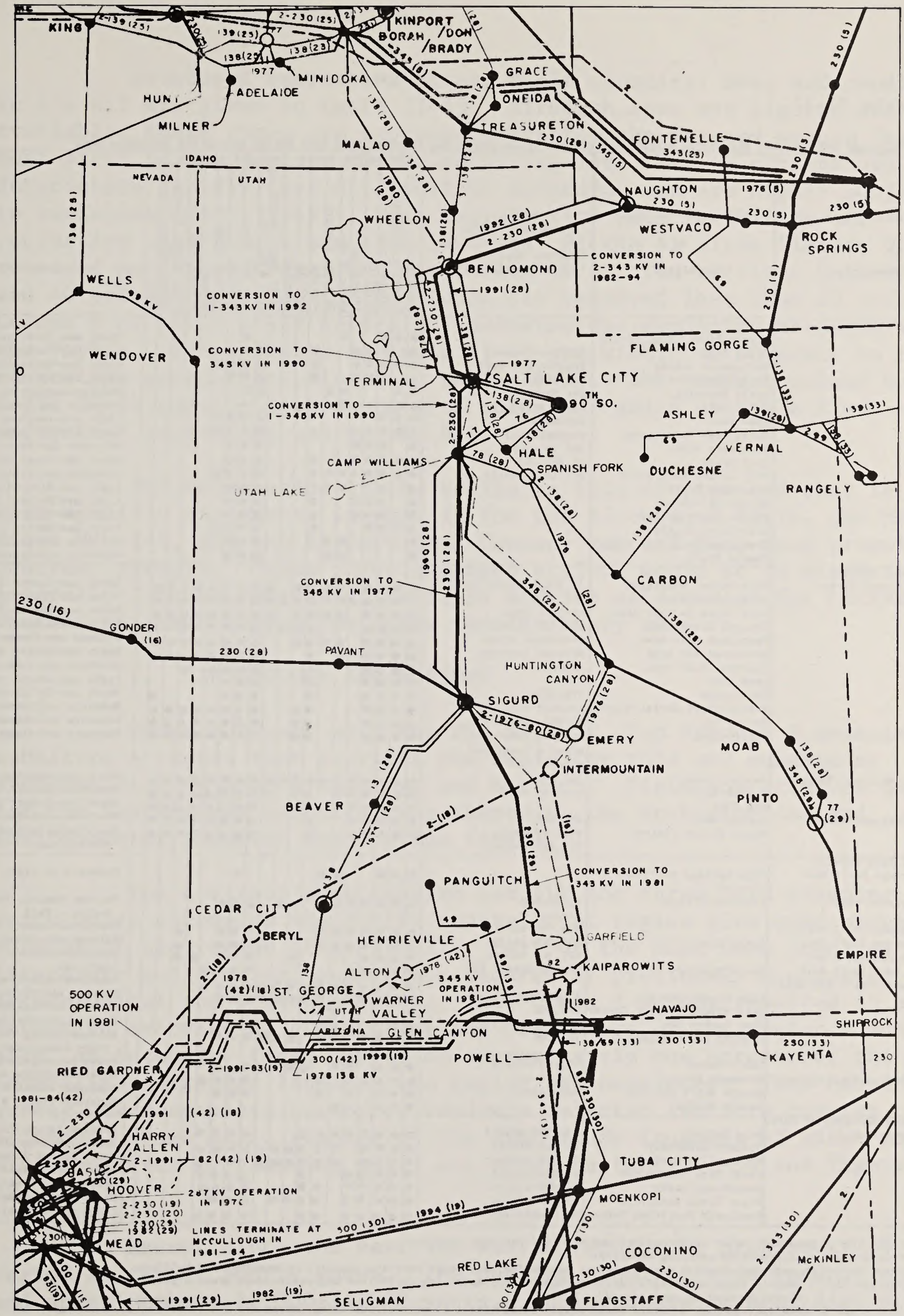


Figure II-20.--Transmission line network.

Table II-32

Local, Regional and National Recreation Attractions and Use Areas within the Southern Utah Coal Region Recreation Influence Zone

Administering Agency or Ownership	Recreation Use Area or Attraction	1976 Recreation Visits or Visitor Days Use (Where Available)	Major Recreation User Attractions: Scenery	Pleasure Driving	Nature Study	Wildlife	Archeology	Works of Man	Cultural History	Hunting	Fishing	Swimming	Other Water Sports	Hike - Back Pack	Camp and Picnic	Solitude	4-Wheel & ORV	Skiing	Snowmobiling	Other Winter Sports	Gather Resource Prods	Other	Comments*
Bureau of Land Management																							
	Virgin River Gorge (I-15)		●	●	●			●							●								Heavy use-Interstate Highway
	Cocks Comb	Recreation use	●		●	●	●			●				●	●	●	●						Light use-Geological formation
	Cottonwood Canyon	records not kept	●	●	●	●	●			●				●	●	●	●						Light use-Geological formation
	Paria Primitive Area	for these areas,	●		●	●	●			●				●	●	●							Light use-Spring-Fall
	Paria Townsite	but Area	●	●				●	●					●	●								Moderateuse-Spring-Summer-Fall
	Movie Sets	Administrators	●	●			●	●	●						●								Moderate use-Summer
	Cane Beds	estimate	●	●	●									●	●	●	●						Light use-yearlong
	Coral Pink Sand Dunes	accumulative	●	●	●	●	●			●				●	●	●	●						Heavy use-Off road vehicle
	Escalante River	use in excess	●		●	●	●							●	●	●							Moderate use-Primitive values
	Calf Creek	of 700,000	●	●	●	●	●			●				●	●	●							Heavy use-local fall&spring
	Hole in the Rock Trail	visits annually.	●	●	●	●	●	●	●	●				●	●	●	●						Moderate use-Historical value
	Honeymoon Trail		●		●			●	●					●	●	●							Light use-Historical value
	Hackberry Canyon		●		●	●	●			●				●	●	●							Light use-Natural Env values
	Phipps-Death Hollow		●		●	●	●			●				●	●	●							Light use-Natural Env values
	Vermillion Cliffs		●	●	●	●				●				●	●	●	●						Light use-Spring & Fall
	Dominguez-Escalante Trail		●					●	●					●	●	●							Moderate use-Historical values
	Temple Trail		●					●	●					●	●	●							Moderate use-Historical values
U.S. Forest Service																							
Dixie National Forest	Pine Valley Mountains	52,800 visitor days	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●		Heavy use-Summer & Fall
	Navajo Lake Area	652,800	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		Heavy use-Summer-Fall-Winter
	Duck Creek Springs Area	visitor days	●	●	●	●		●	●	●	●		●	●	●	●	●	●	●	●	●		Heavy use-Summer-Fall-Winter
	Mammoth Creek Area	296,300 visits to	●	●	●	●				●	●	●	●	●	●	●	●	●	●	●	●		Heavy use-Summer
	Panquitch Lake Area	developed sites	●	●	●	●		●	●	●	●			●	●	●	●	●	●	●	●		Extreme use-Summer & Fall
	Brianhead Ski Area	special interest	●	●	●	●		●		●				●	●	●	●	●	●	●	●		Heavy use-Winter Skiing
	Cascade Falls Area	areas.	●	●	●	●				●				●	●	●	●		●				Moderate use-Summer
	Lava Beds		●	●	●	●				●				●	●	●							Light use-except viewing
	Red Canyon	328,800	●	●	●	●				●				●	●	●					●		Heavy use-Spring-Summer-Fall
	East Fork of Sevier River	visitor days	●	●	●	●				●	●			●	●	●	●	●	●	●	●		Moderate use-Summer
	Barney Top	80,000 visits to	●	●	●	●				●	●			●	●	●	●	●	●	●	●		Moderate use-Summer
	Griffin Top	special interest	●	●	●	●				●	●			●	●	●	●	●	●	●	●		Moderate use-Summer
		areas & developed																					
		sites.																					
Fishlake National Forest	Beaver Canyon	197,000	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		Heavy use-yearlong
	Puffer Lake	visitor days	●	●	●	●	●	●		●	●		●	●	●	●	●	●	●	●	●		Heavy use-Summer & Fall
	Big Flat		●	●	●	●	●			●				●	●	●	●	●	●	●	●		Heavy use-Summer & Fall
Kaibab National Forest	Jacobs Lake	263,000	●	●	●	●	●			●				●	●	●	●	●	●	●	●		Heavy non-resident travel
	North Kaibab Plateau	visitor days	●	●	●	●	●			●				●	●	●	●	●	●	●	●		Heavy non-resident & fall
		922,200 visits																					hunting use
National Park Service																							
Pipe Springs Nat'l Mon	Pipe Springs Nat'l Mon		●	●	●			●	●						●								Moderate to light visits
Zion National Park	Zion Nat'l Park	1,090,000	●	●	●	●	●	●	●		●	●		●	●	●							Extreme Summer, Heavy
		visits																					Spring - Fall
Bryce Canyon Nat'l Park		626,200 visits	●	●	●	●	●	●	●					●	●	●			●				Heavy use-Summer & Fall
Grand Canyon Nat'l Park	North Rim	433,000 visits	●	●	●	●	●	●	●					●	●	●			●				Extreme use-Summer
Cedar Breaks Nat'l Mon		411,300 visits	●	●	●	●					●			●	●	●		●	●				Heavy use-Summer
Capitol Reef Nat'l Park	South District	25,000 visits 2/	●	●	●	●	●							●	●	●	●						Light use
Glen Canyon Nat'l Rec Area			●	●	●	●	●	●	●	●	●	●	●	●	●	●	●						Heavy use-yearlong
	Lake Powell (Total)	1,061,700	●	●	●	●	●		●	●	●	●	●	●	●	●							Extreme use-Spring-Summer-Fall
	Carl Hayden Visitor Center	223,300	●					●	●														Extreme use-yearlong
	Glen Canyon Dam	Not Available	●	●				●	●														Extreme use-yearlong
	Wahweap Rec Complex	701,300	●	●	●	●		●	●		●	●	●	●	●	●							Extreme Spring-Fall
																							Heavy Summer use
	Lee's Ferry	95,700 visits	●	●	●		●	●		●	●	●	●	●	●	●							Heavy use-yearlong
Navajo Indian Reservation	Monument Valley	Figure not	●	●	●	●	●		●					●	●	●	●						Moderate visits & use
	Navajo Nat'l Mon (3)	maintained	●	●	●		●		●					●	●	●							Moderate visits & use
	Navajo Bridge		●	●	●			●															Moderate visits & use
Utah State Division of Parks and Recreation 1/	Snow Canyon	130,300 visits	●	●	●	●	●	●	●	●				●	●	●	●						Extreme Spring-Fall visits
	Gunlock Reservoir	63,900 visits	●	●	●	●		●	●	●	●	●	●	●	●	●	●						Heavy yearlong fishing pres
	Minersville Reservoir	70,300 visits	●	●	●	●		●	●	●	●	●	●		●		●						Heavy Spring Summer Fall use
	Coral Pink Sand Dunes	47,600 visits	●	●	●	●	●			●				●	●	●	●						Heavy Spring Fall ORV use
	Kodachrome Basin	11,900 visits	●	●	●	●	●		●	●				●	●	●	●						Moderate to Light visits
	Otter Creek Reservoir	25,500 visits	●	●	●	●	●		●	●	●	●		●	●	●							Heavy Spring-Summer-Fall use
	Escalante Petrified Forest	No Statistics	●	●	●	●	●		●	●				●	●	●	●						Light use-undeveloped

* Light Use -- generally below environmental and designed carrying capacity.
Moderate Use -- approaching carrying capacity.
Heavy Use -- at carrying capacity during most of use period, but above carrying capacity on weekends and holidays.
Extreme Use -- usually above acceptable carrying capacity for major use facilities and environment areas visited during managed or open season.

1/ Visits are to developed portion at State Parks only. Total visits to attractions being served are not recorded.
2/ Estimated.

Developed recreation sites, their capacity, use, and condition in the RIZ are given in table II-33. Although some use figures are not available, those shown are representative for the managed season for most sites in the region. Sites receiving more than 40 percent use deteriorate rapidly, are difficult to maintain, and are highly subjected to vandalism (USFS, 1965). User satisfaction with facilities and recreation experiences are also lowered. Of the 41 sites listed, 25 received more than 40 percent use during 1976. Ten received between 20 and 40 percent use, and the remaining six received less than 20 percent. Column 8 of table II-32 generally indicates the condition of sites with the region. Sites listed in table II-43 are within or adjacent to the recreation attractions listed in table II-33. The comment column on table II-33 should be reviewed with columns 7 and 8 of table II-32 to understand recreation use in the RIZ.

The information in the tables in this chapter and that in the site-specific statements in part II for the Alton coal field, the Mono Power No. 1-5, and the El Paso Coal Company Red and Blue mine proposals contrast sharply. These three proposed actions would be in areas that generally lack recreation attractions and are seldom used for recreation whereas adjacent recreation areas receive heavy use.

7. ARCHEOLOGY AND HISTORY

Under contract with the GS, Wayne T. Van Wagoner & Associates submitted a report that provides the basis for this and subsequent sections dealing with archeology and history. Field and archival data for the Van Wagoner report were gathered by the Archeological and Environmental Research Corporation (AERC).

The contract area covered ten BLM and three USFS planning units which encompass the entire central coal region plus some areas outside of the region (fig. II-22). Part of the AERC work involved a literature and archival search for records of previously documented archeological and historic sites. This Class I survey resulted in a narrative overview of the history and prehistory of the region. Additionally, an intensive field survey of approximately one percent of the Federally controlled lands in the region was completed. This Class II survey was a complete survey of randomly selected 160 acre quarter sections. Some basic results of the AERC study (numbers of sites and site densities by planning unit) are shown on table II-34 and figure II-22.

Except along the east and west margins, the prehistory of the region is rather poorly known. The outline prehistory is known, however, and spans perhaps 12,000-14,000 years. Included are several distinct archeologically defined cultures or cultural periods, including: The <u>Paleo Indians</u> (big game hunters-ca. 12,000 B.C. to ca. 500 B.C.), <u>Desert Archaic</u> (hunters/gathers-ca. 6,000 B.C. to ca A. D. 1), <u>Fremont-Kayenta Anasazi</u> (sedentary agriculturistic-ca. A.D. 700 to ca. A.D. 1250),

Table II-33

Selected Developed Recreation Sites; their Capacity, Use, and Condition for the Southern Utah Coal Region Recreation Influence Zone

Administering Agency or Ownership -1-	Developed Site Name and Type -2-	Season of Use and Length of Season -3-	PAOT 1/ -4-	1976 2/ Recreation Visits -5-	1976 3/ Recreation Visitor Days Use -6-	1976 4/ Use % of Capacity -7-	Comments: Condition and needs at facilities, season of use, intensity of use compared to carrying capacity, etc. -8-
Bureau of Land Mgmt Dixie Resource Area	Red Cliff Rec. Site	1/1 to 12/31(365 days)	155	7,200	10,800	30%	Good condition, heavy spring & fall use, needs some additional facilities
Arizona Strip R.A.	Virgin River Rec. Site	1/1 to 12/31(365 days)	570	NA 5/	---	--	New site-adjacent to Interstate 15.
Vermillion Cliff, R.A.	Ponderosa Grove C.G.	5/1 to 11/30(214 days)	55	NA	NA	35-40%	Satisfactory condition, heavy spring, summer, fall use.
Escalante Resource Area	Calf Creek Rec. Area	4/1 to 11/30(245 days)	250	15,000	7,000	30-40%	Good condition, heavy spring-fall use, moderate summer use.
U.S. Forest Service Dixie National Forest	Pine Valley Campground	6/1 to 9/15(107 days)	215	17,500	14,700	32%	Moderate summer use, some rehabilitation needed. 6/
	Oak Grove Campground	6/1 to 10/15(137 days)	90	10,000	5,600	23%	Moderate use-good condition.
	Navajo Lake C.G.	6/15 to 9/15(93 days)	190	11,500	28,600	81%	Extreme summer use-reconstruction and expansion needed.
	Te-Ah Campground	6/15 to 9/15(93 days)	210	11,500	28,900	74%	Extreme summer use needs expansion and rehabilitation.
	Panquitch Lake North C.G.	6/1 to 9/15(107 days)	210	16,500	41,300	92%	Extreme summer-fall use needs expansion and rehabilitation.
	Sprucea Campground	6/15 to 9/15(93 days)	180	9,500	22,000	66%	Very heavy summer use, needs expansion and rehabilitation.
	Duck Creek Campground	6/1 to 9/15(107 days)	620	44,000	108,900	82%	Extreme summer use needs expansion and rehabilitation.
	Panquitch Lake South C.G.	6/1 to 9/15(107 days)	90	9,900	13,000	67%	Very heavy summer use needs expansion and rehabilitation.
	Pine Lake Campground	6/15 to 9/15(93 days)	170	---	16,400	52%	Heavy summer use, good condition, needs expansion.
	Blue Spruce Campground	6/15 to 9/15(93 days)	30	---	4,200	75%	Extreme summer use, fair condition, needs expansion and rehabilitation.
	Posy Lake Campground	6/15 to 9/15(93 days)	170	---	13,600	43%	Moderate to heavy summer use-good condition-expansion needed.
Fishlake Nat'l Forest	Little Cottonwood C.G.	5/15 - 11/15(185 days)	93	35,500	14,000	41%	Same as above.
	Little Reservoir C.G.	6/1 to 10/30(152 days)	67	19,600	9,000	44%	Heavy summer use-expansion and rehabilitation needed.
	Kents Lake Campground	6/1 to 10/15(137 days)	212	20,300	14,800	25%	Moderate summer use-some rehabilitation needed.
	Anderson Meadow C.G.	6/1 to 9/15(107 days)	50	16,500	6,200	58%	Heavy summer use-some rehabilitation and expansion needed.
	Ponderosa Picnic Area	5/1 to 10/30(183 days)	120	9,700	6,600	31%	Moderate summer use-good condition.
Kaibab Nat'l Forest	Jacobs Lake Campground	5/15 to 11/1(170 days)	240	NA	30,000	80%	Extreme summer-fall use needs expansion and rehabilitation.
	DeMott Campground	5/15 to 11/1(170 days)	100	NA	11,000	80%	Same as above.
U.S. Park Service Cedar Breaks N.M.	Point Supreme C.G.	6/15 to 9/15(92 days)	100	NA	NA	25-35%	Moderate summer use-good condition.
	Point Supreme PicnicSite	6/15 to 9/15(92 days)	40	NA	NA	25-35%	Same as above.
Zion Nat'l Park	South Campground	5/15 to 9/15(108 days)	730	177,400	177,400	35%	35% yearlong % of capacity, extreme spring, summer, fall use-needs supplemental campgrounds outside of Nat'l Park. 75% capacity use in spring, summer and fall.
	Watchman Campground	1/1 to 12/31(365 days)	1,175				
Bryce Canyon Nat'l Park	North Campground	5/1 to 11/1 (214 days)	555	NA	NA	50%	Extreme summer use, light in spring and fall, good condition.
	Sunset Campground	6/1 to 9/10 (102 days)	625	NA	NA	50%	Same as above.
Glen Canyon Nat'l Recreation Area	Wahweap Campground and Marina	1/1 to 12/31(365 days)	1,550	701,300	102,900	70%	Extreme use-good condition, needs expansion.
	Lee's Ferry	1/1 to 12/31(365 days)	280	95,700	49,800	96%	Same as above.
	Carl Hayden Visitor Ctr	1/1 to 12/31(365 days)	NA	223,300	NA	NA	Heavy use-parking needs expansion.
North Rim Grand Canyon	North Rim Campground	5/1 to 12/30(184 days)	700	205,100	165,100	128%	Extreme use-fair cond.-needs expan.
Capitol Reef Nat'l Park	Cedar Mesa Campground	1/1 to 12/31(365 days)	32	3,600	NA	31%	Moderate use-good condition.
Pipe Springs Nat'l Mon.	-- --	1/1 to 12/31(365 days)	NA	27,500	NA	NA	Light use-good condition.
State of Utah Parks and Recreation	Snow Canyon Campground	1/1 to 12/31(365 days)	*146,000	130,300	NA	89%	Facilities good condition-extreme fall and spring use-needs expansion.
	Gunlock Reservoir C.G.	1/1 to 12/31(365 days)	*120,000	63,900	NA	53%	Same as above.
	Mineraville Campground	1/1 to 12/31(365 days)	*100,000	70,300	NA	70%	Extreme summer, fall use-good cond. needs expansion and traffic control.
	Coral Pink Sand Dunes Campground	1/1 to 12/31(365 days)	* 81,000	47,600	NA	59%	Heavy spring and fall use (ORV) needs expansion.
	Kodachrome Basin C.G.	1/1 to 12/31(365 days)	* 60,000	11,900	NA	20%	Light to moderate use-good condition.
	Otter Creek Campground	5/1 to 11/30(214 days)	* 54,000	25,500	NA	47%	Heavy summer use-fair condition, needs expansion and rehabilitation.
	Escalante Petrified Forest Campground	1/1 to 12/31(365 days)	undeveloped	NA	NA	--	Needs developed facilities.

* Yearlong capacities as determined by Utah State Division of Parks and Recreation.

1/ Theoretical developed capacity of developed site, expressed in the number of people the site can accomodate at one time (PAOT).

2/ Recreation Visit - one person visiting the site - no time element calculated or involved.

3/ Recreation Visitor Day Use - an aggregate of 12 hours by one or more persons.

4/ Use as a percent of capacity is based on the managed season of use (length of season x PAOT). Well managed sites generally receive between 20% and 40% use. Beyond 40%, sites deteriorate rapidly, require heavy maintenance and user experience levels diminish from overcrowding, (i.e. loss of privacy and solitude, increase in noise, disturbances, etc.).

5/ NA - not available or not applicable.

6/ Rehabilitation may include hard-surfacing (paved roads, trails, parking spurs, etc.) of parts of sites to protect soils and vegetation. It may also include installation of traffic control devices (barriers) to prevent ORV encroachment and damage to adjacent soil and vegetation resources.

Table II-34. --Comparison of Class I and Class II Site Totals and densities between planning units

	General Sample Area Totals		Sites by Planning unit				Sample Area Comparisons			
Column	1	2	3	4	5	6	7	8	9	10
PLANNING UNITS	Totals	Without site	Previously recorded Class I	Newly Recorded Class II	Totals	Site Density[1] Class II	With Sites Class II	Site Density[2] Class II	% of Planning Unit Area[3] Class II	Density Ranking[4] Class II
BLM										
Cedar	4	1	47	10	57	2.50	3	3.33	75.00	ML
Escalante	72	23	698	199	897	2.76	49	4.06	68.10	M
Garfield	6	0	2	23	25	3.83	6	3.83	100.00	ML
Paria	0	0	354	0	354	0	0	0	0	-
West Zion	1	1	1	0	1	0	0	0	0	L
Zion	10	2	76	21	97	2.10	8	2.63	80.00	ML
U.S.F.S.										
Aquarius	17	5	28	53	81	3.12	12	4.42	70.60	M
Boulder	3	0	110	24	134	8.00	3	8.00	100.00	MH
Markagunt	15	11	78	8	86	0.53	4	2.00	26.70	L
Paunsaugunt-S	40	32	160	10	170	0.25	8	1.25	20.00	L
Total	168	75	1554	348	1902	-	93	-	-	-
Overall Density (from totals)	-	-	-	-	-	2.07	-	3.74	-	ML
Percentage of Sample Areas with sites (from totals)	-	-	-	-	-	-	-	-	55.40	-

Note: Class I - the existing site records of the entire planning unit

Class II - survey selected quarter sections of a one percent sample area

[1] Average number of Class II sites per sample area by planning unit. (Column 4 divided by Column 1)

[2] Average number of Class II sites per sample area with sites. (Column 4 divided by (Column 4 divided by Column 7)

[3] This figure represents the percentage of quarter sections that probably contain at least one site in each planning unit. (Column 7 divided by Column 1)

[4] This figure is a ranking based upon the density ratings in Column 8.

Key:
- L = 0 to 2 (Low)
- ML = 2.01 to 4 (Moderately low)
- M = 4.01 to 6 (Medium)
- MH = 6.01 to 8 (Moderately high)
- H = 8.01 to 10 (High)

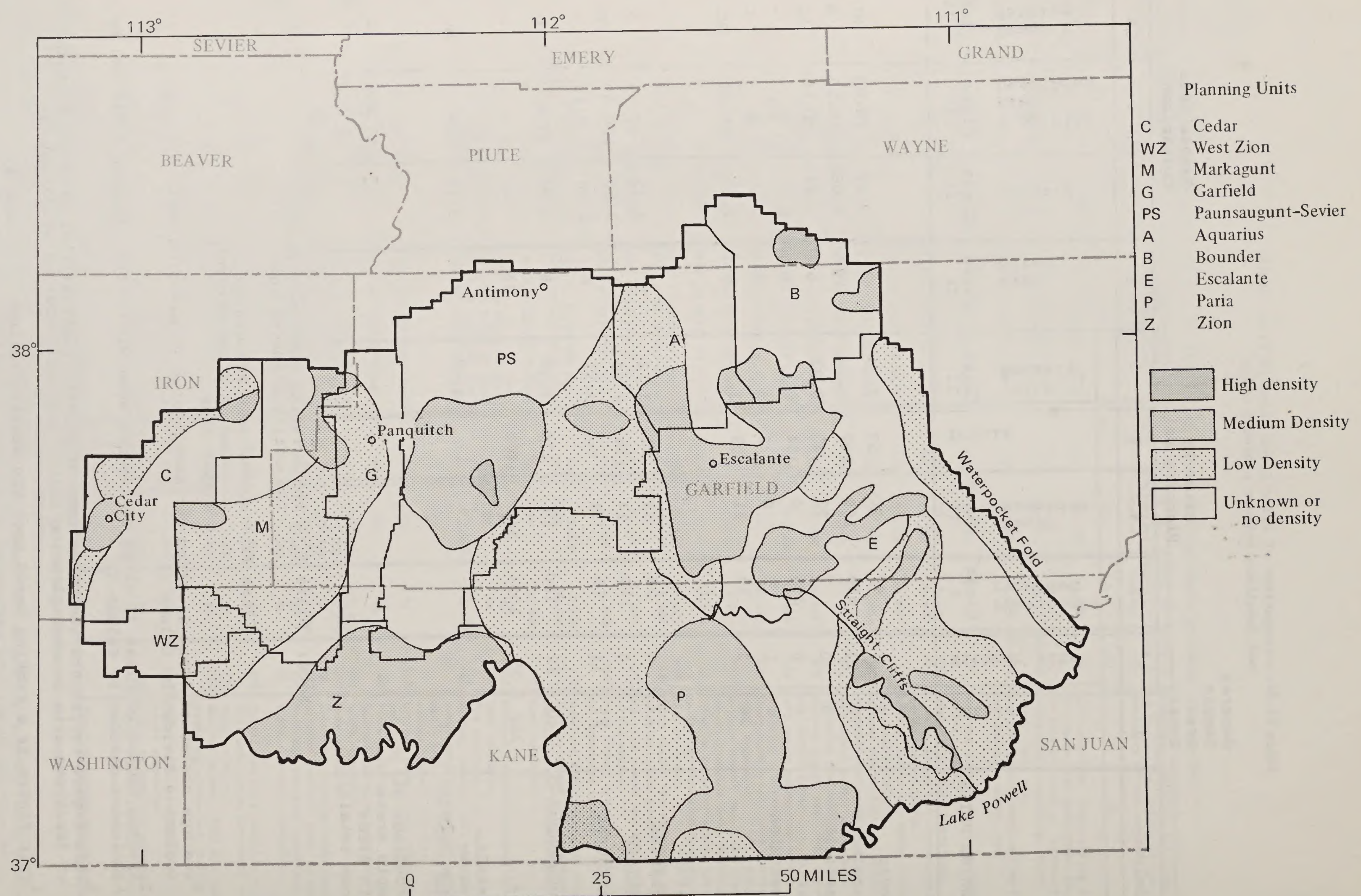


Figure II-22.--Site density by Federal planning unit.

Southern Paiute (hunters/gatherers ca. A.D. 1100 to the historic period). A detailed discussion of these groups may be found in the AERC Class I survey report.

A variety of site types were indentified by AERC. A correlation of site types by Planning Unit, based on Class II survey results is presented in table II-35. Located throughout the AERC reports are tables correlating site types with various geological, geomorphological, and environmental factors and variables. Three particularly germane points can be abstracted from these data: (1) The most common site is the "lithic scatter," a site type that has not been dealt with seriously in research archeology in the region; (2) a large number of sites could not be assigned a cultural affiliation, which in part underscores a lack of full understanding of the prehistory; and (3) archeological sites are not spread randomly over the landscape; certain conditions tend to cluster sites and (or) site types.

The first documented non-Indian passage through southern Utah was by the Dominguez-Escalante expedition of 1776-77. The somewhat later trade-oriented Spanish Trail passes through the extreme western part of the region. The region was also visited in the earlier 1800's by the government explorer John C. Fremont and the famed trapper Jedediah Smith.

Very soon after their arrival in the Salt Lake Valley in 1847, the Mormons initiated exploration/colonization missions on a substantial scale. One of the the initial thrusts was into the Parowan/Cedar Valley area (which is slightly outside the region), with a view to both settlement and development of iron ore west of present day Cedar City. Settlement in other areas of the region came later and did not succeed as readily as in the western parts, due in part to Indian problems in the 1850's and 60's. The Long Valley area, Panguitch, and Kanab were initially settled sparsely with subsequent spreading out to the east from Panguitch and Kanab. The region was settled primarily for agriculture and stock raising, although lumbering was a factor in Panguitch.

Few historic sites were recorded by the AERC Class I and II surveys, in part, because many are on private land. Also, much of the historic resource is still in use. Further, obvious historic sites have not been documented in the individual records that AERC mainly work with. There are however, several sites that are of considerable historic interest, particularly those associated with early settlement.

Archeological sites and some historic sites have special characteristics that make them extremely vulnerable to certain types of activities. They are localized and immovable, individually unique, nonrenewable, and located on or near the ground surface. They are very valuable to science when undisturbed, but next to valueless when badly disturbed. Further, they are of general interest to the public at large and considered as personal private playgrounds by relic collectors.

Table II-35.--Correlation between number of sites and site type by planning unit

Planning units	Lithic scatter	Hunting	Kill-butchering	Quarry	Temporary camp	Extended camp	Single habitation	Multiple habitation	Petroglyph	Rock shelter	Granary	Miscellaneous	Total
Cedar-----------	9	0	0	0	1	0	0	0	0	0	0	0	10
Escalante River-	103	3	0	3	37	16	18	9	1	4	3	2	199
Garfield--------	20	0	0	0	3	0	0	0	0	0	0	0	23
Paria-----------	-	-	-	-	-	-	-	-	-	-	-	-	-
West Zion-------	0	0	0	0	0	0	0	0	0	0	0	0	0
Zion------------	9	0	0	0	5	6	0	0	0	0	1	0	21
Aquarius--------	34	1	0	12	4	0	0	1	0	1	0	0	53
Boulder---------	14	1	1	1	4	1	1	0	0	1	0	0	24
Markagunt-------	7	0	0	0	1	0	0	0	0	0	0	0	8
Paunsaugunt-Sevier--------	10	0	0	0	0	0	0	0	0	0	0	0	10
Total-----	206	5	1	16	55	23	19	10	1	6	4	2	348

As a result, cultural resources have traditionally been highly sensitive to any form of ground disturbing activity, whether construction/development related or related to the vandalism of people who dig and collect for "recreational," acquisitional, and even profit motives. Thus, there has to date been a great deal of resource destroyed or damaged, both intentionally and unintentionally, to the point that sites of any size or substance that do not show some damage are almost non-existant. While there are now better safeguards against construction/-development loss, there are still few really effective checks against vandalism and loss from this source is on-going.

The February 7, 1978, Federal Register has been reviewed along with lists provided by the Utah State Historical Society. While there are several properties in the region that are either on the National Register or have been formally nominated to the Register, there are none that will be directly impacted by coal development, as presently conceived. There may, however, be other sites found during preconstruction surveys. These will have to be evaluated in accordance with 36 CFR 800 as part of site-specific studies.

8. ESTHETICS

Visual characteristics that would be affected, other than those addressed for the site-specific proposals in part II, include: a) the communities of Kanab, Mt., Carmel, Glendale, Orderville, and Alton, Utah; and b) seen areas along primary and secondary travel routes where ancillary facilities would be added to support the proposed mining operations described in part II.

Kanab, the largest of the five communities, has a well defined business district that has developed over the past 40 years to encourage and support tourism and the movie and television industry. Some facilities (trailer parks, motels, rock shops, cafes, etc.) have also been developed in Mt. Carmel, Glendale, and Orderville to attract tourists using U.S. Highway 89. These communities have more of a rural-ranching character and residential lots are generally located in connection with small ranch and farming operations, whereas Kanab's residential district is more urban.

The community of Alton has a totally rural-ranching character with no commercial facilities. Buildings are generally older, wooden frame, and on large lots associated with farming and ranching operations.

No single building architectural style predominates in any of the communities, and the style varies from pre-1870 two-story, brick, masonary, and sandstone structures to modern single-story dwellings. Some historical building may exist, dating back to early attempts by the Mormon Church to establish the "United Order."

Straight Cliffs and steep slopes form an enclosed landscape between Long Valley Junction and Mt. Carmel Junction. Vegetation includes ponderosa pine, aspen, and manzanita on side slopes with wet meadows, willow and cottonwood in the canyon bottoms. Viewing is generally restricted to less than 1 mile. Land ownership is mixed Federal, State, and private. The natural landscape character has been modified to include the communities of Glendale, Orderville, and Mt. Carmel, as well as fenced pastures, outlying ranches, powerlines, and some scattered summer homes.

The area between Mt. Carmel and Page, Arizona primarily presents a panoramic viewshed where viewing long distances is both possible and important. The predominant vegetation type between Mt. Carmel and Kanab is pinyon juniper, but some cottonwood, big sage, tamarisk, and willows are found in the canyon bottoms along perennial and intermittent water course. Foreground-middleground (up to 5 miles) areas between Kanab and Page, Arizona are generally sparsely vegetated with desert shrubs, grasses, and forbs. Background (beyond 5 miles) areas are made up of varied geological formations such as the Straight Cliffs Formation comprising the southern extreme of the Kaiparowits Plateau and the Cockscomb.

Man-made intrusions between Mt. Carmel and Page, Ariz. include the community of Kanab, some scattered ranches, fences, and powerlines. The majority of these intrusions do not generally detract from the viewing experience or natural landscape character of the area.

Scenic quality or variety is common (typical) to much of that found throughout the general area. Lake Powell and Glen Canyon Dam, however, are considered to be outstanding visual attractions. In both cases, activities of man dominate the landscape character (dam is man-made and has created an artificial lake). Few people view these man-made intrusions as offensive or as detracting from the landscape character of the area.

Little change in the landscape character or in community character would be expected without the proposed action.

C. FUTURE ENVIRONMENT WITHOUT THE PROPOSED FEDERAL ACTION

1. NATURAL ENVIRONMENT

Population is expected to increase due to normal growth in the region without coal development. Growth of 23,400 people from 1975 to 1990 is anticipated resulting in community enlargement on approximately 900 acres.

Soils will be disturbed by this development, some soil will be lost by wind and water erosion, and there will be a change in land use from natural or agricultural crop production to community use. The paleontology of the region may be affected by the population increase resulting in more people looking for fossil material. Use of water will increase with the population and there may be less water for agriculture. Since there are few emissions envisioned for the region the air quality is basically as described earlier in this chapter.

Better management of domestic livestock grazing has helped to increase the amount and quality of vegetation over the last thirty years. This trend is expected to continue into the future. The present trend toward fewer sheep numbers and a leveling-off or slight upswing in cattle numbers should continue over the next several years.

The projected population increase will cause added pressure on wildlife in the region. Some encroachment on mule deer, turkey, forest grouse, pheasant, and mountain lion ranges would result from urbanization and recreational home development. Some areas would be irreversibly committed to an urban environment, with a loss of species that are incompatible with man's activities and an increase in species adaptable to urbanization. The direct loss of wildlife from illegal shooting, highway mortality, and other activities would increase. Small populations of rare or unique species may be eliminated.

Range improvements, water developments, and better management practices will increase habitat and carrying capacities of some wildlife. Planned transplants of game and nongame species will increase the range of some species and introduce new ones into the area.

Trout streams in the region are probably fished at, or above their production level now. The streams are unlikely to produce any more trout for the expected 1990 population. The greatest threat to the habitat of the St. George and the new snail will come from population growth and the need for domestic water. Historically, the towns of southern Utah have used these and other similar springs for their domestic supplies. This pattern is expected to continue until all spring water is used domestically.

2. CULTURAL ENVIRONMENT

While the exact character of the lands converted to community use without coal production cannot be accurately predicted, it is assumed that 50 percent of the range would be useful for grazing. Based on this assumption, 75 AUM's per year would be lost from domestic livestock grazing starting in 1985, and 100 AUM's per year starting in 1990. The level of use of forest products will increase in the future. Regional population increased over time in the absence of coal mining would be small (table II-36). Much of the recent and projected expansion of population in Garfield and Kane Counties is the result of individuals moving in search of acceptable economic or social conditions. Table II-37 portrays the changes in population growth as not being dramatic and the small increases over time would easily be absorbed in existing low density settlements, assuming newcomers are willing to

Table II-36.--Baseline population and components of change estimated for counties (thousands of persons)

County	1970 Population	Interval Components of Change		1975 Population	Interval Components of Change		1980 Population	Interval Components of Change		1985 Population	Interval Components of Change		1990 Population
		Natural Increase	Migration		Natural Increase	Migration		Natural Increase	Migration		Natural Increase	Migration	
Garfield	3.2	0.2	+0.1	3.4	0.2	+0.2	3.9	0.3	+0.3	4.4	0.3	+0.3	5.0
Kane	2.4	0.1	+1.0	3.6	0.3	+0.3	4.2	0.3	+0.0	4.5	0.3	+0.3	5.1
Garfield and Kane	5.6	0.3	+1.1	7.0	0.5	+0.5	8.0	0.6	+0.3	8.9	0.5	+0.6	10.1
Beaver and Iron	16.0	1.4	+1.0	18.4	1.7	+0.7	20.9	1.5	+0.6	23.0	1.3	+0.2	24.5
Washington	13.7	1.2	+2.1	17.0	2.2	+1.8	21.0	2.1	-0.4	22.7	1.7	-0.3	24.1
Beaver, Iron, Washington	29.6	2.7	+3.1	35.5	3.9	+2.6	41.9	3.7	+0.1	45.7	3.0	-0.1	48.6
Total, Five County	35.2	2.9	+4.3	42.4	4.4	+3.1	49.9	4.3	+0.4	54.6	3.5	+0.5	58.6

(Detail may not add to totals because of independent rounding.)

Source: 1970; U.S. Census of Population. Projection Years and Intervals for Counties; UPED Model Projections, Bureau of Economic and Business Research, University of Utah.

Table II-37.--Community population projections
(Future environment without the proposed Federal Action)

	1980	1985	1990
Garfield County			
Antimony	148	168	190
Boulder	176	199	225
Cannonville	144	164	185
Escalante	772	877	989
Hatch	152	173	195
Henrieville	195	222	249
Panguitch	1,553	1,761	1,987
Tropic	425	483	545
Kane County			
Alton	55	49	46
Glendale	173	157	152
Kanab	3,041	3,335	3,842
Orderville	368	329	324

accept prevailing standards of municipal and economic services. Actually, some communities in the region have had larger population in the past than could be expected under this projection in the year 1990. For example, Garfield County's largest enumerated population was 5,253 in 1940; without coal development, it would not reach that amount even by 1990. Under prevailing and expected economic circumstances, the region's population will continue to be concentrated in Washington and Iron Counties. A discussion of the reasons for this is to be found in the opening pages of the socioeconomic section in chapter IV.

Other impacts expected as a result of normal growth at the low level of production (0-1 mty) and with no Federal action are described in chapter IV and used there as a basis for evaluating impacts at the projected level of 12 mty including the Allen-Warner Valley Energy Project.

Population and commercial activity increases that will occur in southern Utah without coal mining activity will result in an increase in highway traffic. Table II-38 present projections of average daily traffic levels on the selected highway segments shown on figure IV-4. These levels will occur if there is no coal development in the region.

There are several plans proposing new highway segments in the southern Utah region. The decision whether or not to build these segments will be made independent of decisions concerning coal development. The enabling legislation for the Glen Canyon National Recreation Area directed that the Secretary of the Interior, together with the Utah Department of Transportation, study proposed road alinements to determine a route between Glen Canyon City and the Bullfrog Basin. This road is described in the legislation as a "low speed scenic highway." Four feasible routes were identified in 1974 and were discussed in the *General Management Plan, Wilderness Proposal Road Study Alternative and Draft Environmental Statement, Glen Canyon NRA* (fig. II-23). A final route selection and an appropriation of funds from Congress is necessary before any of these plans are developed.

The *Utah Highway Functional Classification and Needs Report 1972-1995*, prepared by the Utah Department of Highways (now DOT) included two parts of these routes for the future. One is a paved highway between Escalante and Hole in the Rock. The other is a route similar to route D1 in the Glen Canyon NRA Road Study. This route is on the north side of Lake Powell between Glen Canyon City and the Bullfrog Basin, almost entirely in the NRA. Of interest is that this route (both the State study and the NPS study) would incorporate the present U-277 from US-89 to the NRA boundary and the present county road inside the NRA from the boundary to the Warm Creek Recreation site (fig. II-23).

The State study also includes a direct route between Kanab and U-15, bypassing Zion National Park.

Table II-38.--Projected average daily traffic (ADT) levels on selected segments of Utah highways base line

Segment[1]	1975 ADT	1980 ADT	1985 ADT	1990 ADT	1990 Trucks
1 -----	5,580	6,718	7,331	7,785	1,332
2 -----	0	0	0	0	0
3 -----	4,660	5,611	6,123	6,502	1,095
4 -----	4,940	5,683	6,289	6,702	1,058
5 -----	4,000	4,601	5,092	5,426	1,009
6 -----	4,275	4,917	5,441	5,798	1,088
7 -----	300	325	358	393	46
8 -----	1,390	1,505	1,658	1,816	314
9 -----	415	474	538	607	88
10 -----	290	331	376	424	58
11 -----	125	143	162	183	22
12 -----	0	0	0	0	0
13 -----	1,475	1,719	1,885	2,124	274
14 -----	355	412	442	486	48
15 -----	1,650	1,924	2,109	2,377	310
16 -----	810	997	1,077	1,144	71
17 -----	135	121	110	105	4
18 -----	20	18	16	16	0
19 -----	30	38	42	48	3
20-----	1,590	2,002	2,191	2,520	301
21-----	1,020	1,230	1,418	1,633	232
22-----	890	1,073	1,237	1,424	200
23-----	890	1,073	1,237	1,424	200
24-----	55	121	1,450	1,800	90
25A----	0	0	0	0	0
26-----	0	0	0	0	0
27 -----	20	24	30	35	0

[1] See map figure IV-2.

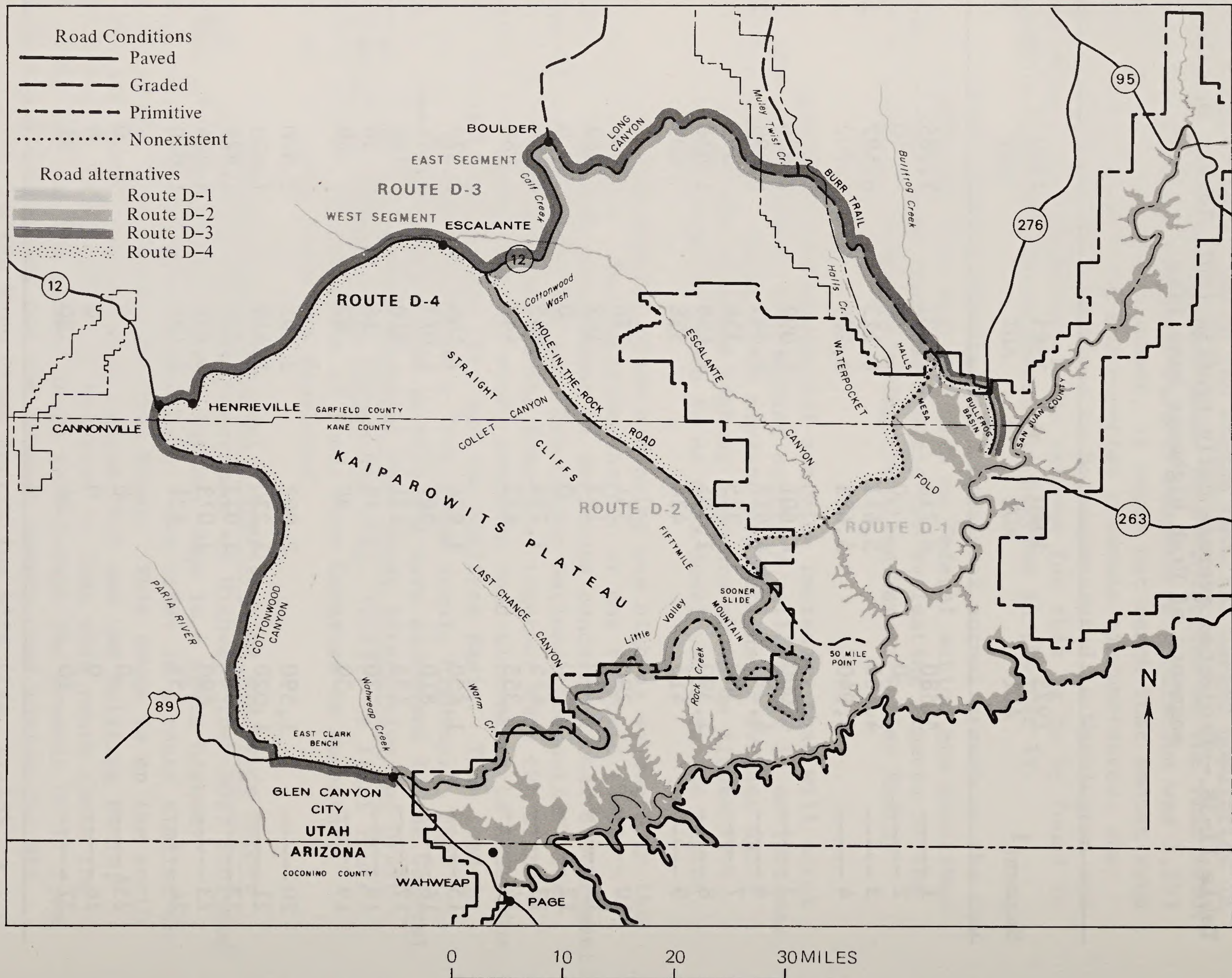


Figure II-23.--Glen Canyon NRA road study alternatives.

In 1973, the Utah Department of Highways (now UDOT) and the National Park Service (NPS) made the Arches/Canyonlands/Capitol Road Transportation study (fig. II-24). This study described roads deemed appropriate and necessary for full utilization of the parks. The roads from Escalante to Hole in the Rock, and from Glen Canyon City to the Bullfrog Basin were among those studied and may be proposed for Federal funding through the NPS's authority to improve exterior park access. Any proposals, however, would have to be submitted to Congress for legislative action and such a submittal must await completion of the Glen Canyon NRA road study and the general management plans and wilderness studies for all four NPS units. The NPS has indicated that other road improvements discussed in this study including, paving the Cannonville to Cottonwood Canyon Road, the Boulder to Torrey Road, the Boulder to Burr Trail Road, the road between I-10 at Fremont Junction and U-24 were proposed by the State Department of Highways. These roads are considered beyond the scope of the exterior park access requirements and would not be eligible for funds through NPS.

The Kane County Planning Commission proposed a highway in 1976 along the route from Glen Canyon City to Henrieville originally proposed as a State highway in the Kaiparowits Environmental Impact Statement. This highway would pass along the west side of the Kaiparowits Plateau.

There are no plans to expand utility service into the area. The increased demands for utilities resulting from growth in population and commercial activities will result in the expansion of existing systems. No railroad construction is projected for the region in the absence of major coal development.

Recreation visits and use will continue to increase within the RIZ at the rate of 7.2 percent per annum based on increases from 1966 to 1976. Total visitations for the three multicounty subregions by 1985 and 1990 if no Federal action is taken are shown on table II-39.

Without coal development, the following changes will occur to the recreation resource within the RIZ:

a) Acute shortages in developed recreation sites for camping and picnicking.

b) Additional conflicts will occur between different user groups and the same dispersed areas.

c) Lowering of fisherman success and possible lowering of hunter success.[1]

[1] Hunter success can be maintained through control of bag limits, length of season, and so forth. Numbers of hunters afield may be lowered, however.

Table II-39.--Recreation visits in the RIZ without coal development[1]

Multi-county subregion	Present recreation visits (1976) residents and non-residents	1985	1990
Color Country	3,791,350	6,957,750	9,856,100
Canyonlands	2,051,300	3,717,500	5,268,800
Northern Arizona	2,550,000	4,636,900	6,570,500

[1] Figure II-25 shows the three multi-county subregions affected by the proposed action.

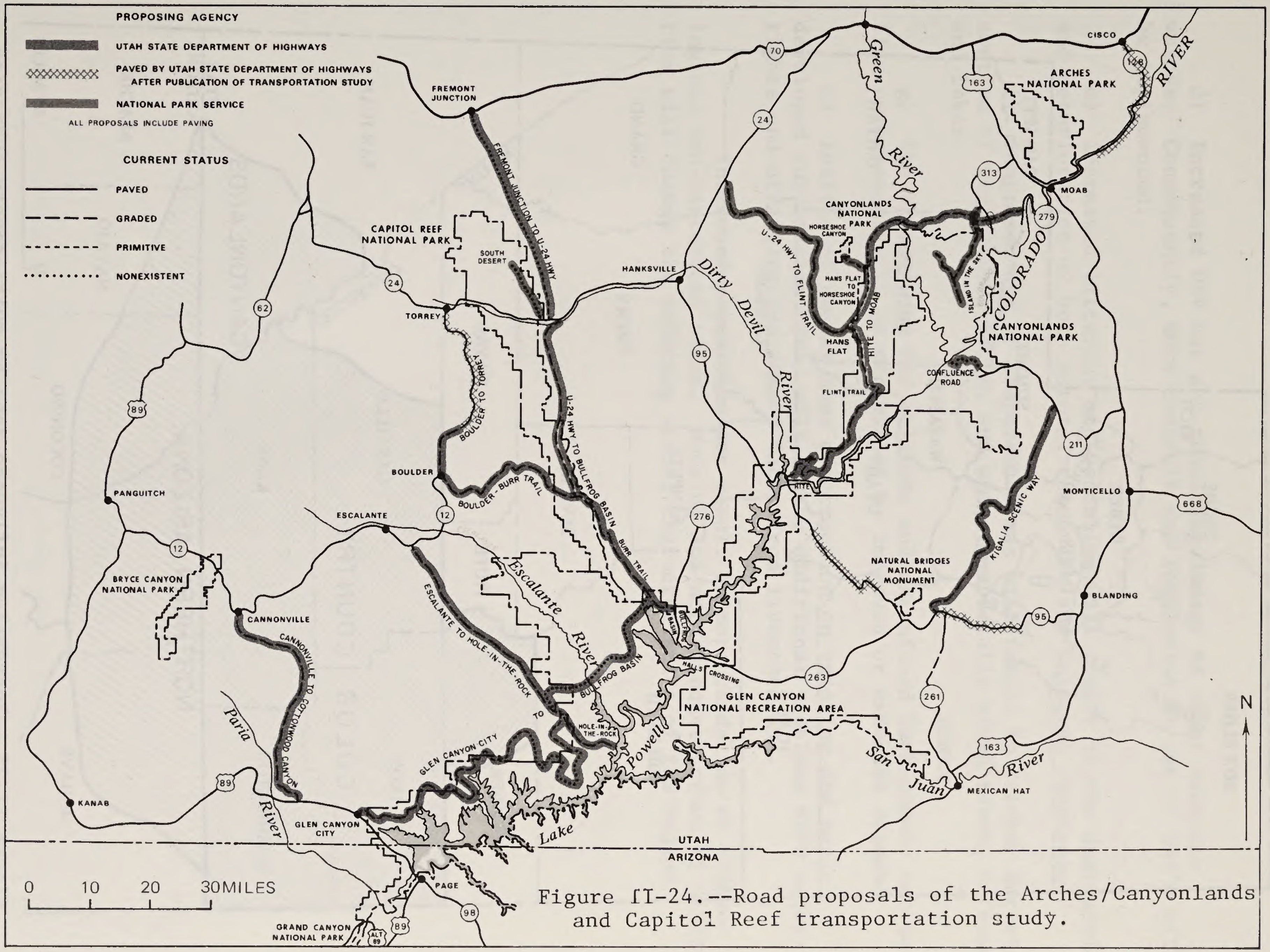


Figure II-24.--Road proposals of the Arches/Canyonlands and Capitol Reef transportation study.

Figure II-25.--Recreation influence zone by multi-county subregion.

d) Increased ORV use and resulting damage to other resource values. Consequently, more controls and regulation on use of ORV's will be implemented.

e) Increased littering and vandalism will result in the destruction and deterioration of both natural resources and cultural resources.

f) Increased use of dispersed areas will result in further deterioration of vegetation, soils, and water, especially along roads, streams, and lakes.

g) The opportunity for solitude and unconfined back-county recreation experiences will be diminished by improved or extended access.

h) Additional summer home construction on existing and newly developed subdivision lots, will create additional problems with water-rights and utilities and remove lands from livestock use.

Increased population may result in more vandalism of archeological and historical sites. Housing and normal construction of utilities will change the existing visual characteristics of the region.

CHAPTER III: PLANNING AND ENVIRONMENTAL CONTROLS

This chapter presents the planning and environmental controls under which the proposed coal mines would be required to operate if approved.

The chapter is in four sections: (]) listing of principal planning and environmental legislation and regulations which control Federal, State, and (or) local government action with their respective applications to coal development, (2) a discussion of land use plans, controls, and constraints, (3) a summary discussion of institutional relationships, and (4) general discussion of the relationship of land use plans to the proposed action.

A. FEDERAL COAL LEASING AND MANAGEMENT ARE CARRIED OUT UNDER THE FOLLOWING LAWS, REGULATIONS, AND POLICY GUIDANCE

Two laws that provide the basic authorities for leasing the Federal minerals, including coal, are: Mineral Leasing Act (41 Stat. 437, as amended; 30 U.S.C. 181 et seq.) and Mineral Leasing Act for Acquired Lands (61 Stat. 913; 30 U.S.C. 351-359).

The law that provides the basis for resource management on public lands is the Federal Land Policy and Management Act of 1976 (90 State. 2743; 43 U.S.C. 1701-1771).

The laws that provide the basis for resource management on National Forest Lands are: Organic Act of June 4, 1897 (30 Stat. 34, as amended; 16 U.S.C. 473-482, 551) and Multiple Use-Sustained Yield Act of June 12, 1960 (74 Stat. 215; U.S.C. 528-531).

These laws are implemented by the Bureau of Land Management (BLM), USDA Forest Service (USFS), and the U.S. Geological Survey (USGS) under the following regulations.

Title 43 CFR Part 3041 provides procedures to ensure that adequate measures are taken during exploration or surface mining of the Federal coal (among other minerals) to avoid, minimize, or correct damages to the environment (land, water, and air) and to avoid, minimize, or correct hazards to public health and safety. This provides the basis for the technical examination.

Title 43 CFR Part 3500 provides procedures for leasing and subsequent management of Federal coal (among other minerals) deposits.

Title 43 CFR Part 2800 establishes procedures for issuing rights-of-way to private individuals and (or) companies on public lands.

Title 30 CFR Part 211 governs operations for discovery, testing, development, mining, and preparation of federal coal under leases, licenses, and permits pursuant to 43 CFR Part 3500. The purposes of the current regulations in Part 211 (5/76) are to promote orderly and efficient operations and production practices without waste or avoidable loss of coal or other mineral-bearing formation; to encourage maximum recovery and use of coal resources; to promote operating practices which will avoid, minimize, or correct damage to the environment, including land, water, and air, and avoid, minimize, or correct hazards to public health and safety; and to obtain a proper record of all coal produced.

Surface Mining Control and Reclamation Act of 1977 regulates the surface mining of all coal deposits and is implemented by the Office of Surface Mining under the regulations in Title 30 CFR Part 700. The Act and regulations provide for:

1. environmental performance standards for surface coal mining and reclamation operations;

2. inspection and enforcement procedures, including the assessment of civil penalties;

3. assistance to small operators in meeting permit application requirements;

4. requirements and approval procedures for State programs;

5. develop performance standards for the Federal lands program;

6. develop the initial regulatory program to be incorporated into coal mining permits issued under State law;

7. requirements and procedures for approval of State mining permits; and

8. requirements for posting, release, and forfeiture of reclamation performance bonds.

In all cases, pursuant to Section 515 of SMCRA and Federal Regulation 30 CFR 715.13, coal mining operations will be required, as a minimum, to restore the lands affected to a condition capable of supporting the use which it was capable of supporting prior to any mining, or higher or better uses of which there is reasonable likelihood. Mining and reclamation plans will not be approved unless the applicant has demonstrated that reclamation to the proposed post mining land use can be accomplished under the mining and reclamation plan.

1. AIR QUALITY

Applicable legislation and regulations relating to air quality include:

1. Clean Air Act, as amended in 1977;

2. National Ambient Air Quality Standards (NAAQS);

3. New Source Performance Standards (NSPS);

4. National Emissions Standards for Hazardous Air Pollutants (NESHAP);

5. Utah Ambient Air Quality Regulations.

The Clean Air Act of 1970 specified that each State would be responsible for ensuring the air quality within its borders and for specifying the way it would be achieved and maintained.

On April 30, 1971, the EPA officially announced the primary and secondary NAAQS (Federal Register 1971). The primary standards were established to protect human health, whereas the secondary standards were established to protect the public welfare from any known or anticipated adverse effects. Standards were put into effect for suspended particulate matter, sulfur oxides, nitrogen oxides, photochemical oxidants, carbon monoxide, and hydrocarbons.

Utah Air Conservation Regulations presently in effect were promulgated September 25, 1971, and revised May 22, 1977. These regulations do not officially adopt the NAAQS, but NAAQS are enforceable in the State. Changes to the Utah regulations are presently being considered by the Air Conservation Committee and are presently in public hearing (April 1978).

The Clean Air Act mandated division of each State and appropriate interstate area into air quality control regions (AQCRs). The Clean Air Act Amendments of 1977 require the States to identify regions and parts of regions that do and do not meet the NAAQS by December 7, 1977, thereby determining which areas are governed by Prevention of Significant Deterioration (PSD) and nonattainment (NA) requirements, respectively. In January 1978, the State of Utah submitted to EPA its initial list of seven NA areas in Utah. The only area potentially impacted by development in this region would be the Cedar City area.

The State of Utah was initially classified a Class II area with the exception of five national parks: Arches, Canyon Lands, Capitol Reef, Bryce, and Zion, which have been classified mandatory Class I. Of these five Class I areas, Capitol Reef and Bryce Canyon National Parks are located in the region (see fig. II-23). At present, neither the State of Utah nor the Indian Tribal Councils has definite plans to reclassify any other areas of the State.

The 1970 Act provided authority to establish "emissions standards" for new stationary sources and for existing sources in categories for which national standards of performance has been established.

The 1977 Clean Air Act Amendments contain major revisions of the 1970 Act with respect to: (1) the announcement of a 3-hour (or less) primary standard for NO_2 unless there is "no significant evidence" that such a standard is needed to protect public health, (2) the identification of regions within individual States (air quality control regions) that do and do not meet the NAAQS which determines whether the areas are governed by prevention of significant deterioration (PSD) standards or by nonattainment (NA) requirements, (3) the strengthening of enforcement mechanisms for the PSD standards and the NA requirements, (4) the EPA which is required to promulgate PSD regulations for criteria pollutants other than TSP and SO_2 which already have such regulations, and (5) the NSPS for stationary sources.

The 1977 amendments have been passed by the U.S. Congress and are, therefore, law. Specific regulations needed to fulfill the requirements of these amendments are being drafted by the responsible agencies. However, neither the Federal agencies nor the States are relieved of the responsibility for meeting the requirements of the Clean Air Act Amendments of 1977.

2. PALEONTOLOGY

Applicable regulations include the Utah State Antiquities Act (Utah State Code Annotated Sec. 63.18.2-38). This act includes paleontology and requires that a paleontological survey shall be undertaken before mining activities begin, on State land and all provisions of the State Antiquities Act shall be complied with. In the event that paleontological resources are discovered on Federally owned lands, proper Federal authorities shall be notified and their recommendations followed.

The BLM and USGS are currently developing a Memorandum of Understanding relating to the protection of paleontological resources on Federal lands. Those agencies are also developing technical guidelines to define the resource, provide evaluatory criteria, and measures for protection.

When completed, the provisions of these documents will serve as a basis for management of paleontological resources and appropriate protective programs.

3. WATER QUALITY

Applicable legislation and regulations include:

1. Federal Water Pollution Control Act (FWPCA), as amended in 1972; National standards to restore and maintain the chemical, physical, and biological integrity of the Nation's waters were promulgated by the Federal Water Pollution Control Act (FWPCA), as amended in 1972.

2. Water Quality Standards for Utah, June 21, 1976--Utah water quality standards were issued under authority of Utah Code Annotated, 1953, as amended in 1967. Under Title 73, chap. 14 of the Code, the Utah Bureau of Water Quality is empowered to enforce these water-quality standards. Important prescribed standards include those which specify maximum permissible concentrations of dissolved solids, minimum permissible concentrations of dissolved oxygen, and the permissible temperatures of the waters of the State. Other important aspects of the standards are an anti-degradation policy and a stream classification system with specific criteria for numerous classes of waters. Effluent standards and limitations specifying the maximum amounts of pollution and waste which may be discharged into State waters are described.

4. CULTURAL RESOURCES

Applicable authorities include:

1. Antiquities Act of 1906 (34 Stat. 225; 16 U.S.C. 431-433).

2. Historic Site Act of 1935 (49 Stat. 666).

3. Reservoir Salvage Act 1960 (74 Stat. 220);

4. Historic Preservations Act of 1966 (80 Stat. 915; 16 U.S.C. 470);

5. National Environmental Policy Act of 1969 (33 Stat. 852; 42 U.S.C. 4321, et seq.);

6. Executive Order (E.O.) 11593; and

7. Archealogical and Historic Data Preservation Act of 1974 (88 Stat. 174);

8. Federal Land Policy and Management Act of 1976 (90 Stat. 2743);

9. Utah State Antiquities Act (Utah State Code Annotated Sec. 63.18.2-38)--The State of Utah has an antiquities law, applicable to State lands, that is similar in scope to the Federal Act of 1906. Additionally, the various Federal agencies have specific authority to add stipulations to leases, licenses, permits, etc. such as are deemed necessary to protect the environment, including cultural resources.

The Bureau of Land Management and the State of Utah have entered into a Cooperative Agreement outlining actions and interactions that have or will be taken to insure full compliance pursuant specifically to the National Historic Preservation Act and EO 11593.

Both Federal and State antiquities acts regulate antiquities excavation and collections, and both protect historical values on public lands. They provide for fines and (or) imprisonment for violators of their provisions. The Historic Preservation Act requires that certain Federal undertakings be submitted for review by the National Advisory Council on Historic Preservation. Executive Order 11593 requires all Federal agencies to cooperate with the nonfederal agencies, groups, and individuals to insure that Federal plans and programs contribute to the preservation and enhancement of nonfederally owned historic and cultural values.

No mining or rights-of-way will be approved until the surface management agency has coordinated professional cultural resource (cultural resources include archeological, architectural, and historical remains) surveys with the Utah State Historic Preservation Officer and received his written comments, and review. Additional surveys and mitigation may be necessary if surface evidence indicates further evaluation is necessary.

5. RAILROADS

The Interstate Commerce Act (49 Stat. 543, 49 U.S.C. 1(18) requires the prior approval from the Interstate Commerce Commission for the extension or new construction of a line of railroad or the abandonment of operation of a line of railroad. Exempted from this authority are spur, industrial team, switching, or side tracks located wholly within one state. Commission certification is based on a balancing of the relevant economic, technical, and environmental factors.

6. MINERAL PROTECTION

Oil and gas leases are in effect for much of the area. Priorities for mining or drilling for oil and gas on public lands are established by the Conservation Division of the U.S. Geological Survey. Mining operations approaching wells or bore holes that may liberate oil, gas, water, or other fluid substances must be approved in accordance with 30 CFR 211.17 and 30 CFR 211.63. Impacts on oil and gas areas can be mitigated largely by agreements among operators where significant impact on oil well siting or pipeline location arises. In extreme instances of conflict, technology is adequate through directional drilling, drainage practice, recovery of wells lost, pipeline and flow line relocation, pillar recovery, and mining methods to adequately mitigate impacts which might arise.

7. ENDANGERED SPECIES

Applicable authorities include the Endangered Species Act of 1973 (87 Stat. 844). This Act provides protection for listed species (both flora and fauna) and their critical habitat. Prior to authorization of any significant disturbance of lands under lease or permit, the Department of the Interior will require that a survey be made to determine if listed species or their habitat may be present. If it is determined that listed species or their habitat may be present and could be affected by the proposed activities, appropriate consultation with FWS will be carried out. No activities will be authorized until consultation is completed as per 50 CFR 402 (January 4, 1978).

8. WILDLIFE AND FISHES

Applicable authorities also include the Bald Eagle Protection Act of 1969 (16 U.S.C. 668-668c.). Under this law mining operations will not be permitted in any area where such activities would molest or disturb bald and (or) golden eagles and (or) their nests.

Authorities also include the Fish and Wildlife Coordination Act of 1958. Under this law the U.S. Fish and Wildlife Service will be consulted on matters which would affect the habitat of any fish or associated wildlife resource to enter into a coordination process.

B. LAND USE PLANS, CONTROLS, CONSTRAINTS

In the region, a large number of separate entities exercise land and resource use controls. The Federal sector includes the National Park Service (Capitol Reef, Bryce Canyon National Parks, Glen Canyon National Recreation Area, and Cedar Breaks National Monument), USFS (Dixie National Forest), and the BLM (public lands and mineral estate under certain private lands).

Development, management, use, and control of use on Federal lands has been delegated to these agencies. Controls are effected through issuance or non-issuance of a variety of leases, permits, licenses, etc. Each authorization to use Federal lands contains provisions to control that use. Controls exercised by the Federal government for the subsurface estate are governed by the statutes authorizing the disposition and use of that estate. Foremost among these statutes is the authority for leasing coal deposits and authority to require, as a condition of such leases, an operation-management plan and a reclamation-restoration plan.

A number of State agencies base development and administrative authority over state of Utah owned lands. The State does not have a land use planning act.

Except where controls have specifically been delegated by statute to counties or municipalities, Utah retains total jurisdiction over nonpublic and privately-owned lands. Certain of these lands were conveyed to the State as part of the Act admitting Utah to the Union. This legislation granted Sections 2, 16, 32 and 36 of every township to the State for education purposes. Use and control of these lands (including mineral leasing, rights-of-way, etc.) is governed by Utah law.

Under Utah statutes, counties have authority to effect a wide variety of controls in matters not specifically reserved to the state. The authority applies only to those portions of the county that are unincorporated. A county may regulate and restrict location and use of buildings and structures, and use, condition of use, or occupancy of lands for residency, recreation, agriculture, industry, commerce, public use, and other purposes.

Local government regulations directing land development in the region include Washington, Iron, Garfield, Kane, Wayne and Emery County zoning ordinances, and County Master Plans. County planning documents by the Five County Association of Governments and directives from municipal and county development and planning councils. General recommendations and directives permit the following actions:

(1) Mining is permissible under present zoning ordinances. Environmental stipulations for specific use authorizations may be required as well as close coordination with local officials.

(2) Ancillary facilities and mine development must meet local or county utility and service requirements.

C. INSTITUTIONAL RELATIONSHIPS

1. U.S. GEOLOGICAL SURVEY (USGS)

The Secretary of the Department of the Interior has delegated his authority to supervise exploration and mining operations on Federal coal leases to the Director, USGS. The Area Mining Supervisor, acting for the Director, reviews the mining and reclamation plans and when the plan is determined to be acceptable requests concurrence of the surface management portions from the surface managing agency responsible for the land. Under provisions of 30 CFR 211, he has further responsibility to supervise prospecting, exploration, testing, development, mining, coal preparation and handling, reclamation, and abandonment operations on Federal coal leases. Inspections can be made by the authorized representative of the Secretary on the basis of information indicating a violation of the Surface Mining Control and Reclamation Act of 1977 or the mining permit. Inspections are also made on a random basis of at least one complete inspection each 6 months (30 CFR 721.11(c).

2. BUREAU OF LAND MANAGEMENT (BLM)

The BLM, in consultation with the USGS, formulates the requirements to be incorporated in the mining and reclamation plan for the protection of the surface and nonmineral resources and for reclamation obligations and standards of performance required of the leasee on public lands as specified in 30 CFR 211.40. An area of operations for each lease is established by agreement between the BLM and the USGS and includes that area of the leased, lands required for development, production, and processing operations, including all related structures and facilities. The USGS is responsible for ensuring compliance on all development, mining, and processing operations conducted within the area of operations of a lease, including the enforcement of the surface protection requirements. The BLM is responsible for compliance on the lease outside the geographical area of operations. Inspections are conducted at least once annually. The BLM must concur with mining and reclamation plans as they pertain to surface management before approval is granted by the USGS for commencement of mining operations. Standards and requirements upon which BLM concurrence is based are specified in 43 CFR 3041.

BLM is responsible for authorizing various ancillary facilities such as access road, power lines, communication lines, and railroad spurs on public lands not covered by bases. Rights-of-way are granted pursuant to Title V of the Federal Land Policy and Management Act of October 21, 1976 (P.L. 94-579, 90 Stat. 2743).

The rights-of-way would be approved subject to standard requirements for duration of the grant, right-of-way widths, fees or costs, and bonding to secur obligations imposed by the terms and conditions applicable to the right-of-way grants. The terms and conditions applicable to the rights-of-way are those in 43 CFR 2800 plus any other specific standard requirements and terms and conditions for the right-of-way applications in the proposed actions.

Ancillary facilities on the lease area of operations which are owned by the operating company and are a normal part of the mining and reclamation plan are approved by USGS as part of the mining and reclamation plan.

3. U.S.D.A. FOREST SERVICE (USFS)

The USFS, in consultation with the USGS, formulates the requirements to be incorporated in the mining and reclamation plans for the protection of the surface and nonmineral resources and for reclamation obligations and standards of performance required of the leasee as specified in 30 CFR 211.40.

The USFS must concur with mining and reclamation plans as pertains to surface management before approval is granted by the USGS for commencement of mining operations. Standards and requirements upon which USGS concurrence is based are specified in 43 CFR 3041.

The USGS is responsible for ensuring compliance on all development, mining, and processing operations conducted within the lease. Inspections are conducted at least once annually.

The USFS is responsible for authorizing various ancillary facilities such as access roads, power lines, communication lines, and railroad spurs on National Forest lands not covered by leases. Rights-of-way are granted pursuant to Title V of the Federal Land Policy and Management Act of October 21, 1976 (P.L. 94-579, 90 Stat. 2743).

The rights-of-way would be approved subject to standard requirements for duration of the grant, right-of-way widths, fees or costs, and bonding to secure obligations imposed by the terms and conditions of the right-of-way grants.

Ancillary facilities on the lease area which are owned by the operating company and are a normal part of the mining and reclamation plan are approved by USGS as part of the mining and reclamation plan.

4. NATIONAL PARK SERVICE (NPS)

Special land use permits will be required for any crossing of NPS lands for new roads, improvement to existing roads, utility lines, water supply lines or other activity.

5. OFFICE OF SURFACE MINING RECLAMATION AND ENFORCEMENT (OSM)

The OSM was created to carry out the provisions of the Surface Mining and Reclamation Act of 1977 (PL 95-87) (SMCRA).

Section 523 of SMCRA requires that a Federal lands program which inclues the requirements of this act be promulgated and implemented no later than 3 August 1978. Until the Federal lands program is implemented, the initial regulations as required in section 502 of SMCRA and published in final form (30 CFR 715 and 716) in the 13 December 1977 Federal Register will apply, as modified to all federal coal leases. These regulations will be modified under the authority of section 523(c) and 702(b) of this act to meet the requirements of the Federal Coal Leasing Amendments Act of 1975 (30 USC 181 st seq.)(FCLAA) and the Federal Land Policy and Management Act of 1976 (43 USC 1701-1771) (FLPMA). The basic change in the regulations is that of: (1) post mining land use used to design the reclamation plan will be that which is found in the surface managing agency's comprehensive land use plan; (2) permanent roads, dams, power lines, etc., to be constructed on public lands will meet the design standards of the surface managing agency, and (3) resource data collected in the process of developing the land use plan or lease stipulations will be available for use in developing the reclamation plan.

The following is a discussion of the relationship between specific requirements of the three laws and the proposed actions. The course of action described in the specific sections below serve as mitigatory measures.

Alluvial valley floors west of the 100th meridian and prime farmland.--Soil surveys conducted by the surface managing agency are required to inventory lands classified as alluvial valley floors and prime farmland.

Mining and reclamation plans which propose to conduct a surface coal mining operation on or adjacent to alluvial valley floors shall include baseline data and surveys as prescribed in 30 CFR 715.17 (j)(3) to establish standards which insure the preservation of the hydrologic function of these alluvial valley floors as prescribed in 30 CFR 715.17(j).

Prior to approval to mine on lands classified as prime farmlands the operator will have to provide data to demonstrate that his proposed method of reclamation will achieve, within a reasonable time, equivalent or higher levels of yield after mining as existed before mining. If approved, special soils handling and storing stipulations will be included in the mine plan.

Lands classified as unsuitable for surface coal mining.--Prior to designating lands unsuitable for mining, except those specific tracts of land described in section 522(e) of SMCRA, the surface managing agency shall prepare a statement on: (1) the potential coal resources of the area; (2) the demand for the coal resources; and (3) the impact of such a designation on the environment, the economy, and the supply of coal. This statement shall be forwarded to the Secretary of the Department of the Interior for review along with the proposal for mine and reclamation plan approval.

Archeological historical sites and endangered and (or) threatened species.--Inventories will be conducted on the impacted lands by the operator and reviewed by the surface managing agency. Stipulations necessary to protect these resources will be included in the proposed mine and reclamation plan.

Federal lessee protection.--Prior to approval of a mining and reclamation plan the surface of the public lands will be inventoried for legally installed appurtenances. Agreements with the Federal lessee will be reached or bonds will be obtained to insure the lessees investments are protected.

Reclaimability to present use.--The capability of lands to support the post mining land use will be determined where existing leases are involved, prior to approval of any mining plan. Where the determination is made that certain lands cannot be reclaimed to the post mining land use, surface mining will not be permitted on these lands.

Performance bonds.--Surety bonds are required at time of lease issuance and may be readjusted prior to approval of the reclamation plan.

Use of explosives.--The requirements of 30 CFR 715.19 will be included as a requirement of all mining and reclamation plans submitted for approval.

Water rights.--The area around the proposed mining area will be inventoried for water uses and water rights. Special requirements will be included in a mine and reclamation plan to protect the water rights of others.

Revegetation.--The species and pounds per acre of plant seed to be used in the reclamation process will be listed in the mining and reclamation plan. A complete inspection of reclamation associated procedures will be made at least once every 3 months and a partial inspection will be made at least once each month.

Public Health and Safety.--The authorized representative of OSM has the authority to enter and inspect for compliance with the initial performance standards in 30 CFR 715 and 716. He has the authority to order a cessation of mining or reclamation operations if, in the course of an inspection or investigation, he finds conditions, practices, or violations of the initial performance standards which create an imminent danger to the public health or safety or conditions or practices which can be expected to cause significant environmental harm. The mining and reclamation plans included in this statement were submitted for review prior to the promulgation of initial regulations required under Section 501-502 of the Surface Mining Control and Reclamation Act of 1977 RC 95-87. Therefore, in some cases the mining and reclamation plans may not fully reflect the requirements of the initial regulations. However, in this statement the initial regulations are being included as a modification requirement of the mining and reclamation plans. Both Geologic Survey and the office of the Surface Mining will review the plans which will not be recommended for approval until the plans reflect the requirements of the initial regulations.

6. STATE OF UTAH

Division of Oil, Gas and Mining. This division and the Office of Surface Mining are preparing rules and procedures to implement the applicable initial regulations of the SMCRA.

Division of Health.--Reviews air pollution sources, culinary water sources, water treatment and solid waste disposal areas.

Division of Lands.--Utility lines, roads, and railroads crossing state land would require easements from the division.

Division of Water Rights.--This division authorizes diversion structures, channel modifications, slurry lines and water use.

Dept. of Transportation.--Relocation of highways, highway access, utility line crossings of State and Federal aid highways, and wide and heavy loads require authorization from the department.

D. RELATIONSHIP TO LAND USE PLANS

1. BLM PLANNING

The Management Framework Plans (MFP) for the Cedar, Garfield, Escalante, Paria, Zion, San Rafael and Henry Mountain Planning Units include the entire Southern region and were completed from 1971 to 1975. Escalante, Paria, and Zion MFP were updated in April and May of 1977 to include the site specific coal proposals. The Escalante, Paria and Zion MFP will be updated by the end of 1979. The recommendations and decisions of the MFP allows the development of coal on the Alton, El Paso and Mono Power et. al. mine plans.

No management decisions were made for the conceptual proposals of UP & L, Sunoco and UPB due to the conceptual nature of their plans.

2. USDA FOREST SERVICE PLANNING

The USFS planning governing management in the Southern region is included in the Paunsaugant-Sevier, Aquarius and Boulder Land Management Plans (LMP). A draft Paunsaugant-Sevier LMP and EIS will be published in June 1978. The Aquarius and Boulder LMP were published in October 1973 and April 1975 respectively. The site specific mine and reclamation plan proposals are not located on National Forest land. Management direction in these LMP will not prohibit coal development.

The following management direction relating to coal development is found in the LMP:

a. Prohibit enlarging the road through Red Canyon on the Paunsaugunt Plateau beyond the present right-of-way.

b. Restrict utilities corridor to the canyon south of Wilson Peak and westward toward Hillsdale.

c. Protect and maintain Henderson Rim seen production areas in development of the Jesse Knight property.

d. Mining operations on the Jesse Knight property would not be allowed within view of Pine Lake Recreation area.

e. Limestone development would be allowed if scenic views from Powell Point are protected.

f. Manage exploration and development of mineral and energy resources to protect esthetics and scenic views from the proposed Table Cliff Scenic Area.

3. NATIONAL PARK PLANNING

Management objectives of the Revised Statement for Management of Capitol Reef National Park (8/77) relating to coal development in the region include:

Protect and preserve the environment within the natural area of Capitol Reef National Park. Permit biological, geological, and other natural processes to function with a minimum of human disturbance.

Cooperate with the Forest Service, BLM, other State and Federal agencies, private organizations and interests, and members of the public in:

1. Ensuring that grazing, mining, and other land uses in the park's vicinity are conducted in a manner that minimizes adverse impacts on park resources.

2. Ensuring that regional energy development does not result in deterioration of the Park's air quality, scenic resources, or the experience of its visitors.

3. Close all unnecessary roads into Capitol Reef National Park and restore sites to as natural an appearance as possible.

Management directives provided by the Park Service for the Glen Canyon National Recreation Area, Cedar Breaks National Monument, Bryce Canyon National Park relating to coal development or transportation of coal include:

(1) Propose a utility planning corridor below the dam for the location of transportation and (or) utility systems. (See Glen Canyon NRA Draft EIS 8/77.)

(2) Manage the Escalante River drainage as wilderness. Utility rights-of-way would not be permitted in this wilderness and natural zone (See Glen Canyon NRA Draft EIS 8/77.)

(3). The proposed zoning will not directly affect the mining of coal within the recreation area (except in the vicinity of Spencer and Navajo Points, where the coal is not considered of commercial value, as noted previously). The removal of the recreation area's coal may be permitted, subject to the regulations of a subsequent mineral resources management plan. (See Glen Canyon NRA Draft EIS 8/77.)

(4) Manage to provide intensive water-recreation use, and visitor services and maintain facilities at Wahweap/Lone Rock and Warm Creek areas. These areas are designated development zones which are existing developed areas, relatively elaborate and permanent structures necessary to support recreational activities. Mining is prohibited, however, utility structures are permissible.

(5) Close the area of Hall's Creek to vehicles in Capitol Reef National Park and Glen Canyon NRA and restore the area as nearly as possible to its natural state.

(6) Make a concentrated effort to acquire all lands and interests in the lands, including mineral interests within the parks.

(7) Establish a system for the protection and enhancement of the cultural environment; preserve, restore and maintain objects of historical, architectural and archeological significance.

CHAPTER IV: IMPACT ANALYSIS

A. NATURAL ENVIRONMENT

1. LAND

Environmental impacts on land occur in five general categories: topography, geology, paleontology, minerals (coal and other economically minables), and soils.

At the projected level of 12 mty production and including the Allen-Warner Valley project, 19,500 acres would be disturbed (table I-4).

During its existence, the Alton strip mine would affect 8,300 acres of land surface. Highwalls as high as 160 feet and spoil piles would be created in as many as four areas at a time during mining. Affected land would be returned to its approximate original contour in accordance with the Surface Mining Control and Reclamation Act of 1977; differences in detail would remain, however, and drainage patterns would be slightly altered. About 300 acres would be permanently altered by grading. All these changes would alter erosion.

Installation of the Allen-Warner Valley powerplants and the auxillary coal-slurry pipelines, coal-preparation plant, and necessary powerlines and roads would require some modification of natural land features. Most of this impact is site specific and remote from the Southern coal region and therefore does not cumulate on impact caused by mining. The entire project is the subject of a site-specific environmental statement being prepared by BLM.

On the Kaiparowits Plateau, an underground mining area, subsidence could affect about 3,000 acres in addition to the acreage distubed by surface facilities and strip mining (table I-4).

Studies of subsidence have been made by Brauner, 1972, 1973; Dunrud, 1976; Osterwald and Dunrud, 1977; and Wardell, 1971. These authors present formulae and methods for determining subsidence; their results, however, cannot be used to predict or quantify subsidence accurately in the region because mining conditions there cannot be predicted. A reasonable estimate of maximum subsidence, after Dunrud (1976), would be from 50 to 90 percent of the mined thickness of the underlying coal beds. The greater subsidence occurs where overburden is thinnest and coal-extraction is greatest. Subsidence could be less than expected for deeper beds, depending on mining conditions. The surface area subject to subsidence would range from 90 to about 130 percent of the area of the mine workings.

Surface expression of subsidence could include open and closed fractures in the bedrock; buckled and buldged bedrock; and sinkholes and other depressions. In the areas discussed by the authors cited above, most open fractures range from less than an inch to several inches wide; length and depth of the fractures is rarely more than a few feet. The fractures are generally filled with soil or other debris. Some fractures however, may be as much as 3 feet wide, 950 feet deep and, where the surface is soil-free sandstone, a few hundred feet long (Dunrud, 1976). Subsidence could increase the potential for rockfalls and landslides.

Coal beds that overlie mine workings would be subjected to stress and possible rupture by subsidence; it could cause caving, thus rendering these beds unsuitable for future mining.

Construction and mining near and below cliffs could increase the frequency of land and rockslides. Any single induced landslide, however, would probably involve less than an acre. Colton (in Sargent and Hansen, 1976, p. 81,82) has pointed out the most susceptible formations. It is anticipated that enforcement of 30 CFR part 211 regulations by the Geological Survey will avoid most of this potential impact.

Mining induced earthquakes with Richter magnitudes greater than 4.9 are not anticipated. This magnitude is the highest recorded earthquake within the region. Mine-stress releases, however, could prove hazardous to mine workings, potential landslide areas, and poorly designed and located earth dams and foundations.

Impacts to paleontological resources would consist of losses of plant, invertebrate, and vertebrate fossil materials for scientific research, public education (interpretative programs), and to other values. Losses would result from destruction, disturbance or removal of fossil materials as a result of coal mining activities, unauthorized collection, and vandalism.

A beneficial impact of development would be the exposure of fossil materials for scientific examination and collection which otherwise may never occur except as a result of overburden clearance, exposure of rock strata, and mineral excavation.

All exposed fossilferous formations within the region could also be affected by increased unauthorized fossil collecting and vandalism as a result of increased regional population. The extent of this impact cannot be presently assessed due to a general lack of specific data on such activities.

Because of the present lack of data and accepted evaluatory criteria for determination of significance, no meaningful assessment can be presently made as to the extent and nature of the loss of these paleontological values to science or education, or hence to the significance of potential impacts on the fossil record.

The major impact on coal would be non-recovery of about 50 percent of the coal in underground mines. If longwall mining methods were used, non-recovery could be reduced to about 35 percent. Non-recovery of coal in underground mining may be attributed to the following:

1) coal is left in pillars and barriers to protect against subsidence and caving;

2) beds are too thin to be safely or economically recovered;

3) beds are too thick (more than 12 or 14 feet, dependent on mining equipment) to be completely recovered by current mining techniques;

4) coal is in multiple beds that are too close together to be safely mined.

The minable (recoverable and unminable coal at the projected level of mining (50 to about 90 percent extraction) is given below in millions of tons:

Proposed mine	Estimated in-place coal (in minable beds)	Approximate recoverable coal	Unminable coal
Alton mine (Nevada Power & Utah Internat. Inc.)	212.0	199.0	13.0
Blue mine (El Paso Coal Co.)	12.0	4.5	7.5
Kaiparowits No. 5 (Mono Power Co., et al)	89.0	44.5	44.5 (est.)
Total	313.0	248.0	65.0

Coal-bed fires can cause loss of an unknown amount of coal. Fires can occur through spontaneous combustion and lightning. Such fires can and do occur in abandoned mine workings, generally near the surface; and they may be uncontrollable, especially where air is supplied through subsidence cracks.

Methane and other mine gases can escape to the surface through mine openings and subsidence fractures. The gases can be harmful to vegetation close to the vents.

At a production level of 12 mty, the impact on other minable minerals would be minimal. Lime dust used in underground mining would require about 10 pounds per ton of coal produced or about 7,500 tons per year. The amount is insignificant, and impact relative to additional limestone quarrying and truck haulage cannot be quantified until a source is selected.

Soils would be affected wherever the surface is disturbed by mining, powerplants, ancillary facilities and transportation systems. Secondary impacts would also result from population growth and subsequent increased recreational activities.

Soil is disturbed when vegetation is removed, when it is travelled upon or moved by equipment or when materials are added. Generally, the greater the soil disturbance, the greater the impact. Soil disturbance includes the following: (1) Exposure (removal of protective organic surface); (2) Mixing of materials or horizons; (3) Compaction (decreased pore space and increased density); (4) Displacement (moving from one place to another); and (5) Additives (waste material, chemical pollutants).

Impacts from disturbance would basically include changes in the ability of the soil to support vegetation; changes in manageability (operability); and impacts to air, water, and land by sediment deposition, where erosion is involved.

Total projected acreage of soil disturbance is about 9,095 acres from developing the 3 mines at the projected production level, 9588 acres from developing the Allen Warner Valley power project and 362 acres from necessary associated community development. (table I-4) Additional soil would be disturbed from increased recreation use, especially by ORV's.

Of the soils that would be disturbed by the proposed activities (excluding the Allen-Warner Valley power project), about 42 percent are moderately deep, 20 percent shallow and rocky (including rock outcrops), and 38 percent deep (greater than 40 inches). The major portion of soil disturbance would occur in the Alton coal field where soil and climatic conditions indicate a fair to good potential for reclamation.

After successful reclamation, the disturbed soils would be returned to at least 90 percent of their original productivity. Special soil handling, soil amendments, reseeding, transplanting, and possibly irrigation would be required, however.

The greatest erosion will occur when soils are bare of vegetation or other protective materials, especially during construction phases and strip mining. Exposed soil is subject to accelerated erosion by both wind and water. In compliance with the Surface Mining and Reclamation Act of 1977, erosion by water would largely be controlled, so that the sediment would remain within disturbed areas. Wind erosion would be more difficult to control and would degrade air quality.

Increased onsite erosion rates of 1.0 to 50 yds^3/acre/yr could be expected by water erosion and 6 to 90 yds^3/acre/yr by wind erosion on disturbed bare soils. An average erosion increase of 10 yds^3/acre/yr is anticipated in this analysis.[1] Actual erosion would be determined by length of time the soil was exposed and the weather during that period. Vegetal protection on the Kaiparowits Plateau is very low under natural conditions, so the difference there between disturbed and undisturbed sites would be much less than the difference at the Alton site. After reclamation, soil erosion rates should be lower than under natural conditions over much of the area, owing to reduced slopes, installation of erosion control structures, mulching, and reestablishment of vegetation.

Research at the Alton coal field by the Intermountain Forest and Range Experiment Station, in cooperation with BLM and Utah International, Inc., indicates that reclamation (with emphasis on revegetation) can be successful in that area (oral commun., Neil Frishknecht and Bob Ferguson, Intermountain Forest and Range Experiment Station 1977, 1978).

Soil impacts from subsidence would not be expected to include much more than some loss of soil in subsidence cracks and local loss of soil moisture owing to rapid infiltration of runoff into subsidence cracks.

2. WATER

Surface runoff may be diverted into cracks because of subsidence and subsequent cracking. The quantity of water that might be so diverted, if any, cannot be predicted, but it could not exceed the average annual runoff (30 acre-ft) from the areas involved and would probably range from zero to one-fourth of the annual runoff. Thirty acre-ft per year is about one-half of one percent of the runoff from the Kaiparowits Plateau. Water so diverted into the ground would not be lost but would add to ground-water storage and would eventually be discharged elsewhere in the same drainage.

[1]Onsite erosion estimates by water are based on the universal soil-loss equation described by the USDA, Soil Conservation Service (1976). The maximum rate of erosion was determined for a fresh spoil pile composed mostly of clay-shale material, with a slope length of 120 ft and a gradient of 60 percent. Wind erosion estimates are based on the system described by the USDA Soil Cons. Sv. (1967, Rev. 1977). Highest rates are for sandy soils.

Mining that drains water from coal beds or saturated beds above the coal will cause local water-level declines, and change the direction of ground-water flow near the mine. Less than one-half of the mining at each proposed site would be in or below saturated beds and might therefore affect ground-water flow. Accordingly, the amount of ground water and saturated sandstone that would be affected is very small--less than one tenth of one percent of that in the region. Formations and possible saturated sandstone that would be disrupted in the Kaiparowits Plateau would include the John Henry and Drip Tank Sandstone Members of the Staight Cliffs Formation and the Wahweap Formation; those in the Alton area would include the Dakota Sandstone and alluvial deposits.

Subsidence and associated cracking would possibly drain saturated sandsontes above the coal beds and increase recharge to lower beds.

The chemical quality of the water is not likely to be affected by drainage of acid waters from mines because, (1) the sulfur content of the coal is low, generally less than 1 percent, (2) the quantities of water and rates of water movement associated with the coal and the overburden material are small--average is less than 40 acre-feet per year per square mile--and (3) most of the water in the study area is highly alkaline--concentrations of bicarbonate are 100-300 mg/l. A recent study of mine drainage and water quality in Colorado shows essentially no coal-mine drainage problems, which is attributed mainly to the low sulfur content of western coal (Wentz, 1974).

The chemical quality of water in the strip-mine area near Alton would deteriorate owing to leaching from disturbed material. Contamination would consist mainly of increased concentrations of sodium, sulfate, and nitrate. Effects on ground water would be restricted to the mined area, as little water movement is expected through the replaced overburden. The concentration of dissolved solids in runoff from the mined area may increase as much as 10 percent, based on data from Black Mesa, Ariz. (Verma, 1977); this increase would have little effect locally and would probably be imperceptible in flows to the Colorado River because the mined area is less than one-half of one percent of the total watershed involved. Because mitigating control measures probably would not be completely effective, sediment movement from spoil piles may be much greater than from undisturbed land, particularly during heavy rainstorms. However, increased sediment movement to the Colorado River would be insignificant (less than 0.2 of 1 percent) because the source area (the spoil piles) at any given time would be extremely small compared to the total contributory areas of Kanab Creek or the Paria River.

Mine drainage may contain concentrations of trace elements, particularly arsenic, iron, manganese, and selenium, slightly greater than normally found in natural streams of the region, as in some coal mines in central Utah, based on unpublished data from Southeastern Utah

Association of Governments, 208 Water Quality Program, 1977. However, quantities of mine drainage would be small--probably less than 10 acre-feet per year--and reasonable enforcement of mitigations regarding effluent standards should prevent any contamination of streams and aquifers.

Water pollution from mine facilities, such as storage and loading areas, tailing ponds, waste piles, and conveyor belts, will be prevented by adequate enforcement of Utah effluent standards and limitations.

Water for mines and possible new communities (table I-4) would likely preempt water presently used for other purposes, mainly agriculture. Such a change in water use would not likely affect Utah's share of Colorado River water or the salinity of the Colorado River.

Water requirements for the projected level, but excluding the Allen-Warner Valley Water project, would be 48,940 acre-feet per year, of which 41,826 would be consumed; of the consumed water, about 40,000 acre-feet per year would be used by the Allen-Warner Valley power project. If water can be made available, as much as an additional 18,000 acre-feet would be consumed by the Allen-Warner Valley water project. Powerplants and slurry lines would use ground water and other water sources discribed in the Allen-Warner Valley site specific EIS being prepared by BLM. Pumping from the Navajo Sandstone in the Alton area would cause water-level declines (written comm., BLM, 1977). As water levels lower, yields of wells and springs that tap the Navajo Sandstone would be decreased or dried up. It is impossible, with the data available, to isolate impacts to specific wells or springs. The impact probably is long term; recovery after pumping stops might require 35 years or more. Other impacts on water related to the Allen-Warner project include the capture by the State of Utah of 36,000 acre-feet per year of water now flowing into Lake Mead, export of about 6,000 acre-feet of ground water per year to Nevada, loss by Nevada of 33,885 acre-feet of Colorado River water credit, and a 77 percent dewatering of Las Vegas Wash; details of these impacts are discussed in the Allen-Warner Valley site specific EIS (BLM).

3. AIR

This information is a summary or is based on the detailed analysis presented in Assemblage of Data on Air Quality in Central and Southern Utah and Assessing the Impact of Coal - Development in this Region on the Air Quality: Final Report (AeroVironment 1977).

Present and projected emissions sources in the region are from 1) the three coal mines at a production of 12 mty as described in chapter I, 2) the Allen-Warner valley project powerplants and the Navajo powerplant near Page, Ariz. (fig. I-2), and 3) other area sources, such as population activity, traffic, etc.

Coal mining emissions would be from both underground and surface mining at the site and from roads leading to the site. Powerplant emissions analysis considers only stack emissions. The area-source emissions would be from activity incidental to mining (i. e., traffic, urban fuel combustion, etc.), as well as from activity of secondary population growth. The year 1975 was selected as the base year for defining present air quality conditions.

AeroVironment (1977) has presented the methodology and data used in estimating emissions for underground and surface coal mining.

Emissions of SO_2, CO, HC, and NO_x would result from fuel combustion. As it is anticipated that electric equipment would be used for underground mining and that traffic from trucks and automobiles would be low in comparison to major highway traffic, these emissions would be negligible. However, numerical values have been computed (AeroVironment 1977).

The regional air-quality impact from coal development was modeled by using the complex terrain models (AVMSTM and modified CDM) to determine the regional TSP, SO_2, and NO_2 impacts under reasonable worst-case meteorologic conditions for short-term averaging times and under representative meteorologic conditions for the annual average. The worst-case meteorologic conditions were based on sensitivity analysis and were adjusted based on actual meteorologic data collected in the study area. The analysis combined the impacts from all coal-development and related sources to determine the combined impact. Pollutant concentrations were calculated to compare with the National Air Quality Standards and with the prevention of significant deterioration (PSD) requirements of the Clean Air Act Amendments of 1977. Pollutants not significantly increased by coal development were not modeled but were assessed qualitatively. The results of the regional analysis for TSP emissions for parts of the region are presented in table IV-1 and figure IV-1.

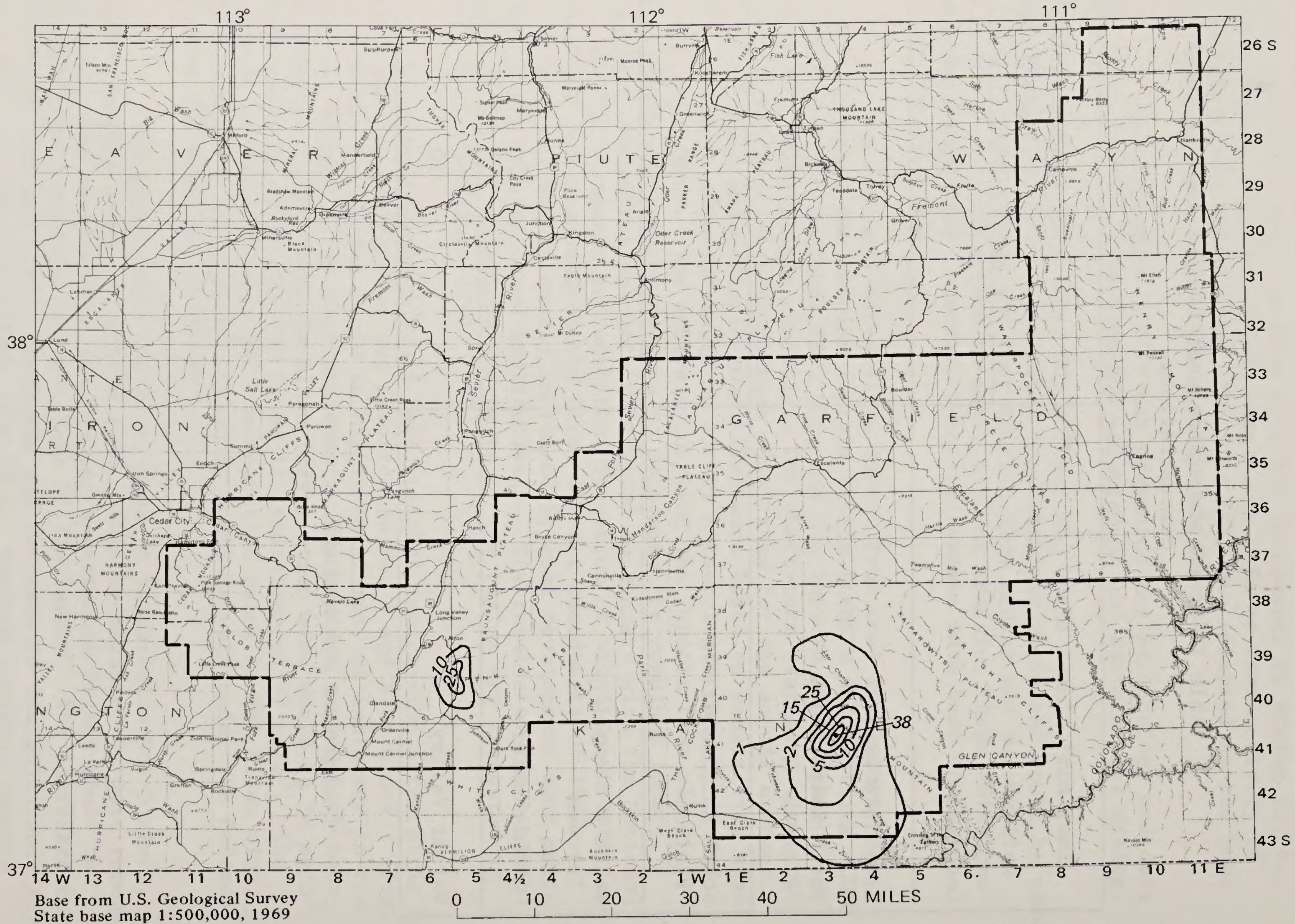
Two main areas would have regional impact--the Alton strip mine area, and the area around the Kaiparowits No. 5 and Blue mines. (fig. I-2, IV-1) The impact would be highly localized, as indicated in the analyses in part II of this statement. The maximum regional 24-hour incremental impact from the Alton (west) strip mine would be 30 $\mu g/m^3$ which would be below the PSD Class II limitation of 37 $\mu g/m^3$. The expected regional 24-hour TSP concentration owing to the Alton mine, with background of 20 $\mu g/m^3$ included, would be well under the Federal 24-hour TSP standard of 150 $\mu g/m^3$.

The area around the Blue, Mono to Kaiparowits No. 5 mines, with extensive usage of unpaved road, would be impacted by dust resuspension. The maximum regional 24-hour incremental impact would be 65 $\mu g/m^3$ which exceeds the PSD class II limitation. The increased dust concentrations are highly localized and decrease to insignificance within 5 miles of the mine sites. (fig IV-1) Maximum regional impacts would not be over the Federal 24-hour standard of 150 $\mu g/m^3$.

Table IV-1.--Maximum increased 24-hour average TSP concentrations

Location	TSP Concentration[1] (ug/m3) 1990 Projected level
Escalante Area & North Kaiparowits Plateau	10
South Kaiparowits Plateau	70
Kolob & Skumpah Terrace Alton Amphitheater	30
Warner Valley	10

[1]background not included.



Base from U.S. Geological Survey
State base map 1:500,000, 1969

Figure IV-1.--Maximum regional 24-hour TSP incremental increase for projected level in southern Utah.

Zion, Bryce Canyon and Capitol Reef National Parks are class I nondegradation areas. The expected incremental 24-hour TSP impact for the proposed coal development at 12 mty would be less than the 10 $\mu g/m^3$ standard at Zion and Capitol Reef National Parks.

The western portion of the Alton lease area was modeled and did not indicate violations of PSD increments at Bryce Canyon National Park. The eastern portion of the Alton lease area is closer to Bryce Canyon and was not modeled. Because of the close proximity (about 3 miles) of the Alton East coal field to Bryce Canyon, it is possible that class I PSD increments would be violated due to TSP emissions from the eastern portion of the lease area. This possibility is currently being analyzed.

The effects of SO_2 emissions were modeled for all sources within each general source type for each subregion. The impacts from specific sources were combined for cumulative analysis.

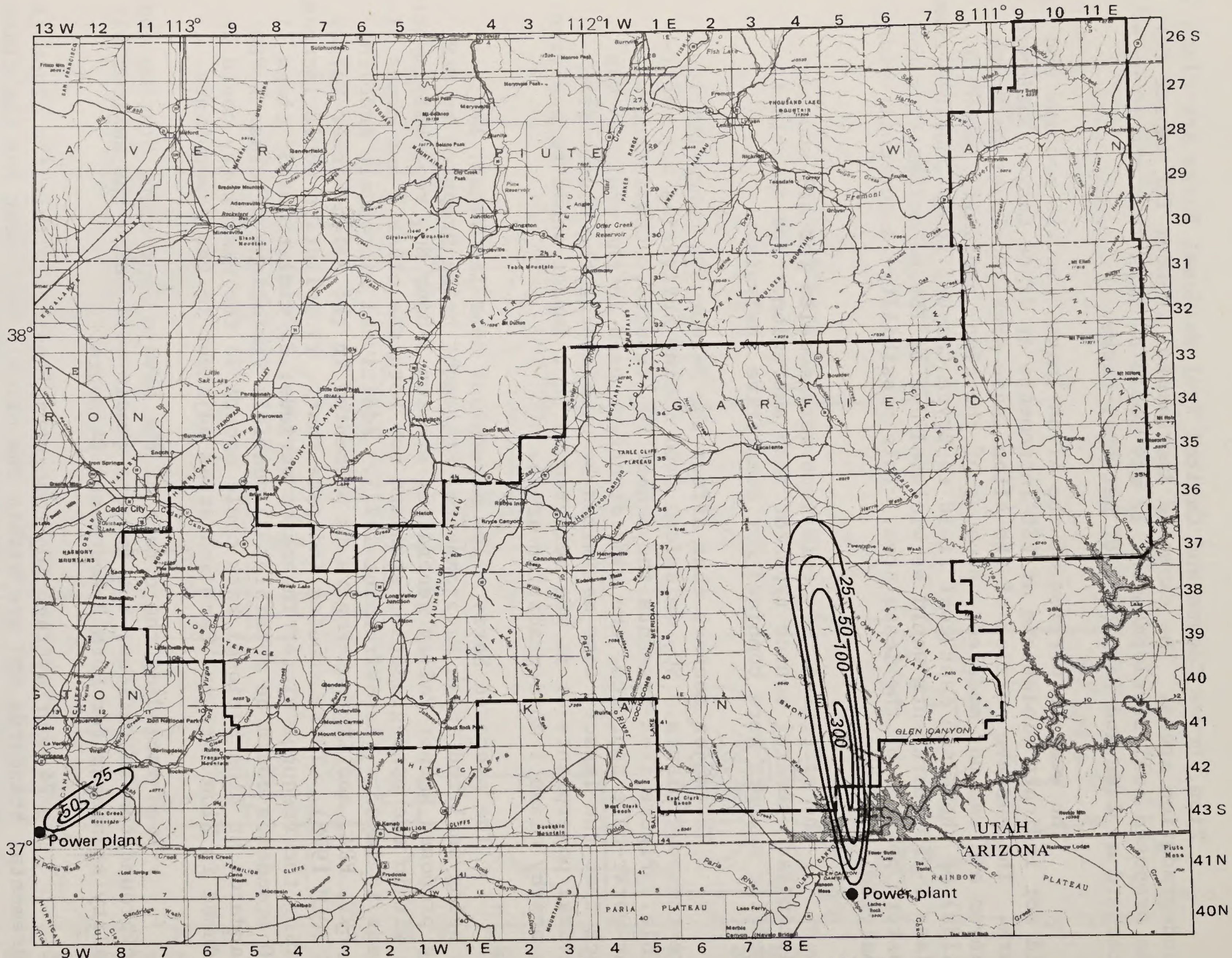
The major sources that affect the 3-hour SO_2 concentrations are the powerplants. SO_2 emissions from mining activities are negligible. Figure IV-2 presents the 3-hour SO_2 results. Consistent with the worst-case approach, the wind direction used in the analysis was such that the impacts were maximized by overlapping the plumes from several powerplants or it was selected so that impact would be analyzed on nearby class I nondegradation areas.

The proposed Harry Allen powerplant near Las Vegas, Nev., is being analyzed in an Environmental Statement being prepared by BLM. The proposed Warner-Valley generating station 3-hour SO_2 regional impact is within the nondegradation standard for both the class I and class II areas it impacts (AeroVironment 1977). Additional microscale modeling by ERT, EPA, and Stearns-Rogers is presented in the Allen-Warner Valley ES (BLM 1978). These studies indicate that: 1) pollution would increase during the frequent winter inversion periods; 2) violations of class II PSD standards could be possible; 3) possible violations of class I PSD standards at Zion National Park could occur; 4) the visibility could be reduced in Zion National Park and areas adjacent to the powerplants.

Even including the effect of the Navajo Generating Station and background concentrations, the impacts remain well below the ambient air quality standards for both 3 hours and 24 hours.

The 24 hour average SO_2 concentrations are within the class II incremental standards and are within the class I increment for the class I areas in the southern region (AeroVironment, 1977).

TSP concentrations from sources in one area of the region would not significantly add to impacts in adjoining areas because of mixing and fallout over the distances involved. Table IV-2 presents



Base from U.S. Geological Survey
Arizona, 1974, and Utah, 1969
State base maps 1:500,000

0 10 20 30 40 50 MILES

Figure IV-2.--Calculated maximum 3-hour SO_2 concentrations (ug/m^3) from existing and proposed power plants, for the projected production level.

Table IV-2.-Results of regional analysis of annual average TSP concentrations

Locality	Annual Average TSP Concentration [1] ($\mu g/m^3$) 1990 Proposed Action
Escalante Area & North Kaiparowits Plateau	5
South Kaiparowits Plateau	37
Kolob & Skumpah Terrace Alton Amphitheater	25
Warner Valley	5

[1] background not included.

the results of the regional analysis of annual TSP concentrations for each area of the region.

The results are presented in figure IV-3, showing isopleths of annual average incremental regional impact. In the southern region, the same emissions sources impacting the short-term averages cause the above-background concentrations to exceed 19 $\mu g/m^3$. The maximum impact is associated with the unpaved roads for the mines south of Escalante, with the impact coming from the Blue and Kaiparowits No. 5 mines (fig. IV-3). The annual average TSP increment would be above the class II PSD incremental limitation of 19 $\mu g/m^3$ within a small area close to the mining operations. This area would approach the Federal ambient standard of 60 $\mu g/m^3$, when background is included. The area around the Alton strip mine also exceeds the class II PSD incremental limitation of 19 $\mu g/m^3$.

All other class II areas are within the class II TSP incremental annual standard, and all class I areas are within the class I TSP incremental annual standard, based on AeroVironment's analysis (1977). However, the eastern part of the proposed Alton mine was not modelled and could possibly violate PSD class I limitations.

The major emitters of SO_2 are powerplants. The anticipated impact of coal development on SO_2 annual average concentrations would be primarily from powerplant emissions. The annual average SO_2 impact from the proposed Warner-Valley powerplant would be small. All class I areas would be impacted by less than the class I annual standard, and all class II areas would be impacted by less than 1 $\mu g/m^3$. When the background and present powerplant emissions are included, the maximum annual average SO_2 concentration would be under 8 $\mu g/m^3$, which is well under the Federal ambient standard of 80 $\mu g/m^3$ (AeroVironment 1977).

NO_2 impacts are primarily associated with powerplant emissions. The emissions from the Warner Valley powerplant would result in NO_2 annual average concentrations (even assuming 100 percent conversion of NO_x emissions to NO_2) of less than 15 ug/m^3, including a background of 10 $\mu g/m^3$. This is well under the Federal standard of 100 $\mu g/m^3$.

Any discussion of visibility must first note that visibility is poorly defined, mainly because it is physiometrically determined. Esthetic visibility also differs from functional visibility, and the color of the obscuring medium will play a role in an esthetic evaluation of visibility degradation to scenic vistas. No visibility standards presently exist, but EPA will issue visibility regulations by August, 1979.

The visual impact of the projected Utah coal developments will occur from a general degradation of atmospheric clarity because of particulate matter emitted from the facilities. A detailed discussion of the assumptions and methodology used in the visibility analysis is given in AeroVironment, Inc. (1977).

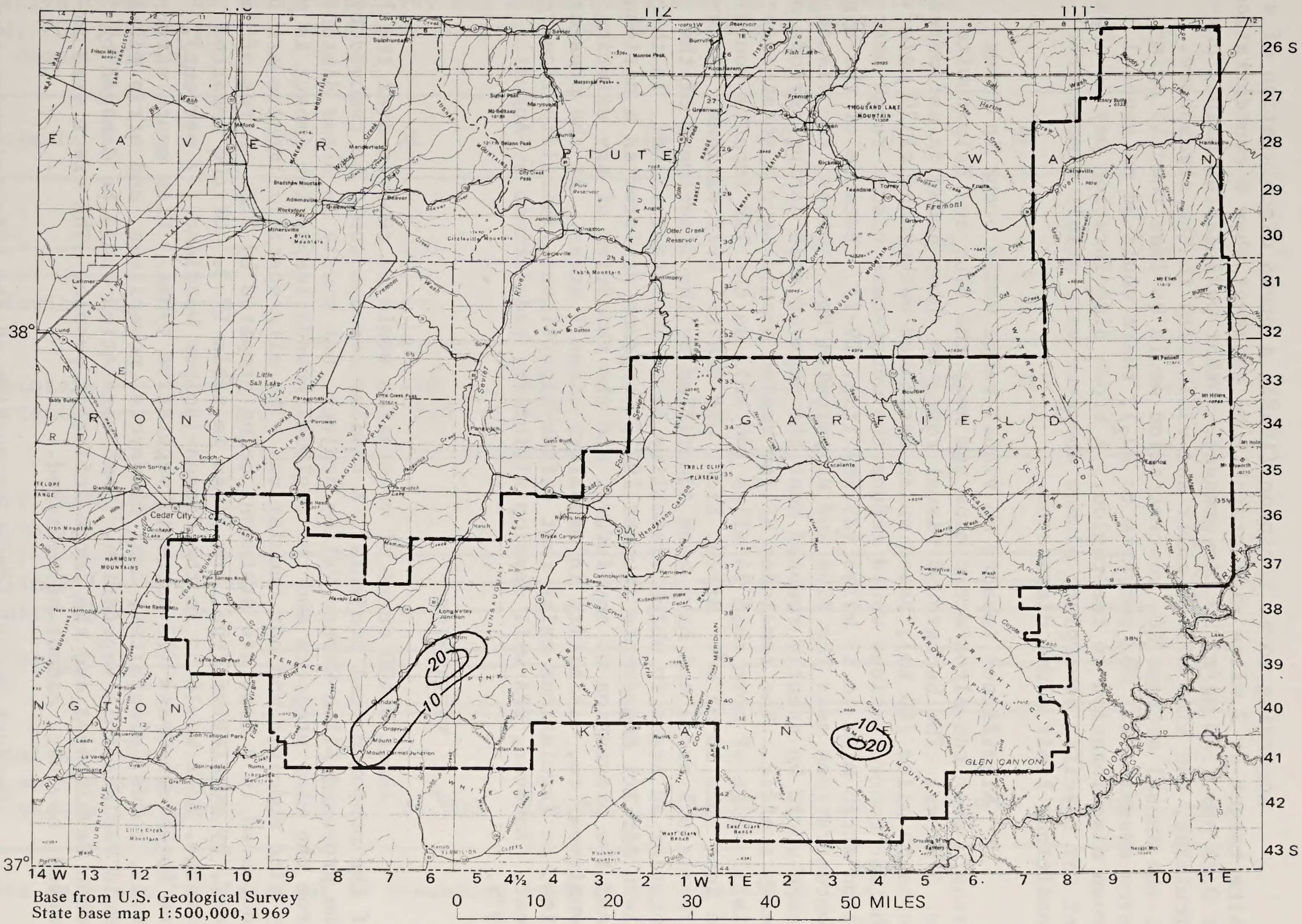


Figure IV-3.--Annual average TSP incremental increases for projected level.

According to E. Robinson (1968), a brown discoloration of a white target at 2 miles will probably be apparent when a concentration of 0.25 ppm (500 $\mu g/m^3$ NO_2 is present. Other pollutants, mainly particulates, can also affect color and visibility in the atmosphere. As the annual average NO_2 concentration would be less than 15 $\mu g/m^3$ (even assuming all NO_x converts to NO_2), there would be no general brown discoloration in the region. A brown discoloration may be apparent for specific powerplant plumes whenever very stable atmospheric conditions limit plume dispersion.

Significant impacts on visual range would occur in three areas: near the Alton strip mine and near the Blue and Kaiparowits No. 5 mines. The background visual range in these areas is estimated to be 35 miles (60 km), based on an estimated background of 20 $\mu g/m^3$. The TSP concentrations would reduce the worst-case visual range near the Alton strip mine to 15 miles (25 km) (fig. IV-1). Because of the high concentrations near the Blue and Kaiparowits No. 5 mines, the visual range would be greatly reduced near the unpaved road during periods of heavy traffic. The remainder of the region should have a worst-case visual range of more than 24 miles (40 km), as the TSP impacts would be less than 10 $\mu g/m^3$. Bryce, Zion, and Capitol Reef National Parks are class I areas and have been identified by the Department of the Interior as areas in which visibility is an important value. In the Clean Air Act Amendments (August 1977) Congress declared as a national goal the prevention of any future, and the remedying of any existing impairment to, visibility in mandatory class I areas. At the present time, no regulations exist that define significant visibility impairment. However, EPA will develop visibility regulations by August 1979.

4. VEGETATION

About 9,400 acres of vegetation would be removed over the life of the proposed coal projects. A similar acreage would be removed by the proposed Allen-Warner Valley project, but mostly in areas distant from the mine projects and the regional boundaries so the impact is mainly site specific and not cumulative. The site specific impacts are being addressed in a separate statement being prepared by BLM. Acres of impact, by vegetative type, are given in table IV-3. Of the impacted acreage, most would be in the Pinyon-juniper Woodland (77 percent), and Sagebrush-Grass (13 percent) vegetative types. Mine mouth structures, roads, plantsites, coal conveyors, powerlines, and strip mines would replace this vegetation. Some vegetation would be damaged by urban development and the large influx of people. The exact area impacted, however, cannot be measured.

Current annual forage production of the affected vegetative types range from almost nothing to as much as 1,500 pounds per acre dry weight, with an average of about 200 pounds per acre (oral comm., Larry Sip, BLM Area Manager, Kanab 1977).

TABLE IV-3.--Acre of impact by vegetative type

(Vegetative types; NP, nonproductive; SG, sagebrush-grass; AL, agricultural land; PG, pinyon-juniper woodland; G, grassland; MB, mountain brush; DS, desert shrub)

Project	NP	AL	G	DS	SG	PJ	MB	Total
Mines:								
Alton	50	420	65	---	1,070	6,380	315	8,300
Blue	---	---	---	---	---	40	---	40
Kaiparowits No. 5	---	---	---	15	---	---	---	15
Subtotal	50	420	65	15	1,070	6,420	315	8,355
Percentage	0.5	5.0	0.8	0.2	12.8	76.9	3.8	100
Ancillary facilities and other:								
Roads[1]								600
Powerlines[1]								140
Community (1990)[1]								362
Total								9,457
Total acreages in southern region by vegetative type	1,300	26,900	163,800	1,052,200	169,000	1,786,900	220,200	---

1/Present data are insufficient to breakdown impacts by vegetative type.

Some of the disturbed sites that have low precipitation and poor soils will be difficult to revegetate. However, experience has shown and research (Aldon and Springfield, 1977; Thames, 1977; Vories, 1976) is showing that, with proper procedures and care, most areas can be revegetated. Irrigation will be required on all sites receiving less than 10 inches of precipitation per year (National Academy of Sciences, 1974). There have been many successful revegetation projects in the Pinyon-Juniper type. This vegetative type accounts for over 75 percent of the area planned to be disturbed.

At the end of 3 years, 90 percent of the disturbed areas will be revegetated to a level of usable forage at least as high as before disturbance (BLM, 1975). It is assumed that after 5 years these sites will produce more usable forage than their present low level (Phillips, 1976).

Mitigation for the loss of native vegetation shall first be aimed at maintaining or restoring the watershed function and soil productivity. In conjunction with that step, disturbed areas shall be revegetated to provide for the planned land uses after completion of the project.

The Pinyon-Juniper Woodland type contains a few fenceposts, Pinyon nuts, and Christmas trees per acre. Most of these products would be removed and thus salvaged before construction. However, these products would not be regrown during the projects. Regrowth would take from 20 to 60 years after rehabilitation.

The mitigations in chapter III should prevent direct impact on threatened or endangered plants from coal production. However, there may be some inadvertent impact (probably minor) caused by urban development and activities of the increased population. The distribution and density of growth of these plants is not well enough known in the areas of potential impact to allow better quantification of the probable impact.

The Endangered Species Act of 1973 requires that all Federal departments and agencies shall protect such species. Some steps which will be taken are 1) all lands planned to be disturbed by coal mining operation will be intensively surveyed to determine whether threatened and endangered plants are present; 2) distribution of threatened and endangered plants will be plotted on maps of proposed disturbed area; 3) size of construction activities will be limited to the minimum; and 4) critical plants and habitats will be avoided in all construction and operation activities.

A projected minor increase in man-caused fires and acreage burned will not cause much impact on the presently small fire problem in the area.

5. WILDLIFE

The total wildlife habitat that would be occupied, disturbed, or otherwise altered by coal mining at the projected level of production is 9,457 acres. Of this amount, 222 acres of wildlife habitat is irrigated crop land, which may be lost owing to change of water use from agricultural to industrial and domestic. After completion of mining, roads, recreation homes and urbanized areas probably would remain, and as much as 1,000 acres of habitat would be permanently lost. The remaining area, although reclaimed over 5 to possibly as much as 100 years, may be altered so that some former wildlife inhabitants may find it unsuitable. Consequently, some species would have a permanent loss of habitat.

The projected population increase of 8,336 (30 percent of the total population increase expected in the area by 1990) attributable to coal mining and energy developments would cause added disturbance of wildlife in more of their habitat. Hunting, fishing, hiking, ORV, camping, and other uses would cause direct losses of wildlife and displacement of species from heavily used areas. Disturbance during nesting, calving, or fawning seasons would lower productivity, and eggs or young would be abandoned. (See recreation section for areas of use and numbers of participants.) The demand for recreational lots and cabins would increase. Most such sites would be in "desirable" areas on private lands in forested mountain areas. Occupation of these lands and the consequent disturbance would cause an additional loss or abandonment of habitat. A minimum of 100 recreation homes, occupying from 25 to 100 acres of land, would be demanded. Most such sites would probably be within the boundaries of the region but, lacking data on location, the impact cannot be further quantified.

Demand would increase for hunting and other recreation related to wildlife. (See recreation section.) Legal hunting and harvest would be regulated by appropriate regulations and bag limits, but illegal activities related to wildlife would increase. Arrests for game law violations in the State increased an average of 16 percent per year from 1971 to 1975. Enforcement personnel remained essentially the same. In Carbon and Emery Counties, which had a population increase related to energy development, the number of wildlife citations increased 41 percent from 1973 to 1975. Figures from Wyoming indicate an almost direct correlation between population growth during 1970-77 and increased arrests for wildlife violations during the same period (Repsis, 1977). Studies in Idaho and New Mexico suggest that the illegal harvest of some game species may exceed the legal harvest (Vilkitis, 1968; Pursley, 1977).

Approximately 30 percent of the total impacts on wildlife resulting from increased population by 1990 would be attributable to developing the Alton, Blue and Kaiparowits No. 5 mines and the Allen-Warner Valley power project.

Construction 100 miles of road and increased traffic would increase wildlife highway mortality. Wildlife highway mortality is directly proportionate to the density and speed of traffic and adjacent wildlife populations (Mc Clure, 1951; Oxley and others, 1974). The vulnerability of species varies; however, young animals or animals inexperienced with high-speed traffic seem to be most susceptible (Hodson, 1960; McClure, 1951). No data are available on the present mortality, except for deer and raptors; mortality cannot be quantified for other species. Studies in other States show an average rate of yearly highway losses ranging from 0.09 to 2.5 wildlife victims per mile (McClure, 1951). The rate for southern Utah would probably fall within that range. Species most susceptible to highway mortality include:

Deer	Kestrel
Rabbits	Rough-legged hawk
Skunks	Golden eagle
Porcupine	Short-eared owl
Mice	Great horned owl
Ground squirrels	Burrowing owl
Pheasant	Common and lesser nighthawks

According to UDWR records of reported raptor mortality in the State during 1974-76, highway mortality (66 birds) was the second most common cause of death. Death by shooting (71 birds) was the most common. Based on the present rate of highway mortality, increased traffic by 1990 would increase highway mortality by 50 percent, or 60 deer annually.

Adding 70 miles of new utility lines would provide perching sites for raptors. This would be beneficial, especially on the Kaiparowits Plateau, where tall trees are scarse. Perching and nesting sites along roadways or in areas open to significant human access, however, would expose raptors to shooting and disturbance. Studies in Utah revealed greater raptor mortality (because of shooting) along utility lines paralleled by a road (Ellis and others, 1969). The incidence of shooting generally increases with the size of the raptor (Brown, 1974), and diurnal raptors are most susceptible (Glue, 1971). The extent of such mortality cannot be quantified; but it would be significant for species of national interest, such as bald and golden eagles. Of the known causes of eagle mortality reported in the State during 1973-76, shooting caused 42 eagle deaths compared to electrocution, the most common cause of reported deaths (52 eagles killed).

New utility lines would create additional flight hazards for all birds, and some would be killed (Stahlecker, 1975; Weir, 1976). Such losses would reduce local populations; however, losses of the peregrine falcon or bald eagle would be of national significance. The proposed lines would not conflict with the hunting territories of nesting peregrine falcons in the area, but migrant birds could be killed (Herren, 1969).

Cumulative impacts on deer, from mining, would include loss of habitat from occupation by structures or other facilities and displacement from habitat or reduced use from disturbance. The acreage that would be affected is shown on table IV-4. Data are not available on deer numbers, forage production or potential carrying capacity; therefore, the number of animals that would be affected cannot be quantified. The impacts to deer would continue for the life of the mines or until facilities are removed and areas reclaimed.

Elk range in the Cedar Mountain-Kolob area would be reduced by summer homes. The amount of range that would be lost cannot be quantified, however. Development on remote areas of the Kaiparowits Plateau may halt the establishment of bighorn sheep bands in areas of historical range. Human activity can cause bighorns to avoid or abandon otherwise suitable range (Irvine, 1969). Encroachment on mountain lion home ranges by mining activities and disturbance would reduce local populations. This reduction cannot be quantified because of lack of data on populations and distribution.

The loss of 362 acres of agricultural and raw land from urbanization attributable to development would reduce local populations of cottontail rabbits. Additional habitat would be lost to mining. A total of 9,457 acres of habitat would be disturbed. Of that area, approximately 362 acres would remain permanently occupied by homes. The consequent reduction in populations cannot be quantified.

About 180 acres of pheasant habitat would be lost to urbanization. Additional habitat, as much as 222 acres, mainly of irrigated cropland, may also be lost because of irrigation water diverted to domestic and mining uses.

Approximately 2,000 acres of sage grouse range (about 50 percent of the present habitat) would be eliminated or significantly altered by strip mining in the Alton area. An undetermined amount of additional habitat may be lost because of urbanization in the Panquitch-Hatch Bench area. The amount or location of this impact cannot be predicted. Present populations are low; therefore, only a small number of birds would be affected. Loss of this habitat, however, would reduce the potential for expansion of flocks.

The Alton strip mine would eliminate or significantly alter approximately 350 acres of summer turkey range and 6,000 acres of winter range. Additional habitat in the Navajo Lake, Strawberry Point, and East Zion areas may also be lost due to occupation by summer home developments and disturbance by recreationists in that area. The result would be a reduction in the long-term productivity of turkey and a reduced potential for expansion of present flocks.

The most significant impacts to raptors would be caused by increased population. Urbanization in Parowan and Cedar Valleys and

Table IV-4. Impacts on Mule Deer Habitat

Component	Range Type		Acres Affected	
	Summer	Winter	Occupied	Reduced Use *
Alton Mine	X	---	8,300**	205
Alton Mine	---	X	---	512
Blue Mine	---	X	40	---
Kaiparowits No. 5	---	X	15	---
Roads	---	X	600	2,944
Utility Lines	---	X	---	---
Urbanization	---	X	138	---
TOTAL	---	---	9,093	3,661

* 50 percent reduction in use within 1/10 mile of perimeter of disturbance center.

** Total area not disturbed over life of mine.

Johnson Canyon would displace bald eagles from roost sites. Illegal shooting and highway mortality were discussed previously, and it seems that little can be done to eliminate these impacts. The bald and golden eagles have been protected by law for several years; however, significant man-caused losses still occur. This trend probably will continue. Loss of mature ponderosa pine trees from strip mining in the Alton area would eliminate roosting and nesting sites for raptors. The temporary elimination of small mammals and reptiles because of strip mining, recontouring, and occupation of habitat by structures would eliminate raptor use on affected areas. After reclamation, the areas may be enhanced for some prey species, and raptors adapted to hunting open country would be benefitted.

The endangered Utah prairie dog would not be directly impacted by the proposed mining. Urbanization could encroach on prairie dog habitat on private lands in Cedar, Parowan, and Sevier Valleys. Resulting losses may be partially offset by ongoing transplanting programs from private to public lands.

Impacts to wildlife from the Allen-Warner Valley Energy system are discussed in the site specific environmental statement being prepared by BLM. Major identified impacts include: disturbance of 9,588 acres of habitat; loss or disturbance of rare species such as the spotted bat, Gila monster, desert tortoise, and desert bighorn sheep; disturbance of nesting raptors in Warner Valley and along the Hurricane Cliffs; possible elimination of the endangered Vegas Valley leopard frog; and a long-term lowering of wildlife productivity. Beneficial impacts would be creation of resting and feeding areas for waterfowl and shorebirds, and an increase of pheasant habitat on irrigated cropland in Washington County.

6. FISHERIES

Fishes and their habitat in the Virgin River and Kanab Creek would be adversely affected by population growth associated with mining and by water use for the Allen-Warner Valley Energy system. The principal anticipated cause of fishery impact would be water depletion, pollution and overfishing. Overfishing would be the major impact in the Escalante, Dirty Devil, and the Upper Sevier tributary streams and the numerous small reservoirs and lakes.

Changing water use from irrigation to domestic use may cause a change in the diversion points which in turn could impact fish habitat: moving diversions upstream would adversely affect fish habitat; moving diversions downstream would cause no change. It is expected that most new diversions would be moved upstream because water quality deteriorates as it moves downstream and water suitable for agriculture may not be suitable for domestic use.

It has been assumed that 50 percent of the domestic water diverted would be returned to the streams as sewage effluent. Downstream flows should be increased but this added flow probably would not benefit fishes because the increased unallocated water might be reappropriated for other uses. Instream flow for fish is not a legally recognized beneficial use of water under Utah laws and has not competed equally with recognized beneficial uses.

Water may be polluted by two major avenues, point source effluents and non-point source effluents. Point source discharges are regulated under Utah effluent standards and limitations. Reasonable enforcement will avoid impact of fisheries.

Non-point pollution will come mainly from surface runoff or subsurface percolation. The deleterious products include suspended sediment, trace elements and dissolved solids. Sediment and trace elements have been suggested as being the most injurious to fish (McAda and others, 1977). Although mining would cause no increase in sediment concentrations (Water section), fish habitat that would probably be impacted by sediment would be Wahweap and Warm Creek bays in Lake Powell and the East Fork of the Virgin River.

Many trace elements, including heavy metals, naturally occur in water in very low concentrations as a result of weathering of rocks. Mining, particularily surface mining, will bring relatively unaltered rocks closer to the surface to be subjected to increased leaching, weathering and erosion. Overburden rocks have higher concentrations of most trace metals when compared to surface and near surface materials or coal (Keefer and Hadlig, 1976). Coal contains small but significant quantities of 25 metallic and non-metallic elements some of which are pollutants (Pratt and Brobst, 1974). No appreciable amount of chemical analysis has been done in the Southern Utah coal region to predict impacts; however, fish habitat in Lake Powell and perhaps the Virgin River system would possibly be affected by trace element contamination from mining coal at the projected level.

Increased population associated with increased coal production would increase the demand for fish resources. In 1975 about 31 percent of all Utahn's fished and about 15,000 were residents of the coal region (USFWS 1977). At the projected coal production level, resident Utah fishermen would increase by 11 percent to around 20,000 and resident Arizona fishermen would increase by 20 percent or to about 3,500 in the area adjacent to the coal region by 1990 (See Recreation).

Trout fishing in southern Utah is limited to the few small streams and reservoirs supporting fishable populations which may be in equilibrium with present fishing pressure, and their fish management programs. An increase in fishermen numbers would increase the amount of waters being "fished out". It is generally recognized that this point is reached when the average catch rate falls below 0.5 fish creeled per hour and fishing pressure declines. Overfishing would adversely affect the Virgin River tributaries, Kanab Creek, Upper Sevier River tributaries, Escalante River tributaries and the small reservoirs, lakes and ponds on Boulder Mountain within the region (See Recreation).

A biological opinion on the impact of the proposed Warner-Valley energy system to the critical habitat of the endangered woundfin was stated in a memorandum. (April 3, 1978; Regional Director, Fish and Wildlife Service to the State Director, Bureau of Land Management, Utah.) In part, this opinion stated:

> "It is our opinion that the Warner Valley Project as now proposed will be likely to jeopardize the continued existence of the endangered woundfin by adversely modifying its present habitat in the Virgin River. This habitat is considered essential for survival of the species and has been proposed for designation as "Critical Habitat," as provided for by the Endangered Species Act of 1973, in the Federal Register, Vol. 42, No. 211, Wednesday, November 2, 1977."

7. INVERTEBRATES

No impact owing to coal mining at the projected level is anticipated on snails listed as continuing proposed for threatened or endangered species listing.

The proposed Allen Warner Valley energy system would probably cause construction and operating workers to immigrate into Washington County. This growth might affect snail habitat and will be considered in the site specific environmental statement being prepared by BLM.

B. CULTURAL ENVIRONMENT AND LAND USE

1. LANDS

Mining plans for development off the Kaiparowits Plateau near the Glen Canyon National Recreation Area indicate the following potential conflicts:

(1) Blue and Kaiparowits No. 5 mine and truck-haul routes would require improved access onto the plateau. Transportation options include improving a jeep trail near Pilot Rock Junction, which crosses the NRA and extends to Glen Canyon City. This road bisects the southeast part of the plateau in a roadless area contiguous to Fifty-Mile Mountain. If the projected work force settles in Page, this route would become a major employee access, as well as a truck hauling route. (See Socioeconomics chap. IV and Transportation chap. IV.) This transportation system includes development of coal and transportating coal from Nipple Bench and Four-Mile Bench, both potential roadless areas. Nipple Bench is adjacent to the NRA, and transportation of coal would be visible from the park.

(2) Upgrading the road between Escalante and the Blue mine to facilitate traffic to Escalante or to provide access to a preliminarily proposed UP&L railroad terminus would include crossing a potential roadless area contiguous to Devil's Garden outstanding natural area and a potential roadless area contiguous to Escalante Canyon.

Contingent upon the EIS, the BLM Paria Planning Unit management framework plan (MFP), recommends providing public lands to satisfy demands for access rights-of-way and tramroads to prospective industrial sites and coal leases in a manner most consisteent with managing other resources.

The Zion Planning Unit MFP identifies the following coal-related impacts within the planning unit, which includes the Alton coal field:

(1) Black, Buck, and Bald Knoll cinder cones are unique features adjacent to or within the proposed Alton mine and should be protected from actions allowing removal of material or interferring with recreational values. The cinder cones are not on the coal lease but may have secondary recreational impacts from increased population in Longview Valley.

(2) Also near the Alton minesite, archeologic sites along Glendale Bench may have secondary impacts from population expansion in Long Valley.

(3) Private land surrounding Muddy Creek near Mt. Carmel has a high potential for speculative development. This area is presently highly susceptible to floods; no surface disturbance should be allowed unless rehabilitation is immediate and effective. Geodes are common throughout the area, which could result in increased surface disturbance from rockhounds. Zoning and use regulations may be required.

(4) The present means of solid-waste disposal in Long Valley communities does not meet Utah health standards and should be negotiated before development.

Coal-related impacts within the Garfield County BLM planning unit include potential expansion of undeveloped subdivisions on public lands, unregulated by county planning or zoning ordinances. Specifically, subdivisions include Bryce Woodland sec. 2, 3, and 10, T. 38 S., R. 5 W., and Sevier River Estates secs. 12 and 13, T. 37 S., R. 6 W. No coal development is proposed within the Garfield Planning Unit. Garfield County is developing permanent regulations for land-use zoning.

2. AGRICULTURE, RANGE, AND TIMBER

The proposals would remove 9,400 acres of vegetation. Some of these losses would be recovered through revegetation. The net loss of grazing capacity would be 1,915 AUM's (see glossary) over the life of the projects, or enough forage to feed 160 cows for 1 year (table IV-5. These impacts would accrue on lands of all ownerships. A similar acreage and about 280 AUM's per year of grazing would be removed by the proposed Allen-Warner Valley energy project.

Table IV-5. Range Impacts

Project	AUM's* per Year	Years	Total AUM's	Percentage of Total
Alton----------	8-46?	23	830	43
Blue mine-----	2	30	60	3
Kaiparowits No. 5-------	1	35	35	2
Roads----------	12	30	360	19
Powerlines----	3	30	90	5
Comm.----------	18	30	540	28
TOTAL	44-82	--	1,915	100

*See glossary

The increased population resulting from the proposed level of action might require as much as 565 acre-feet of water annually for culinary proposes in 1990. If this water were obtained by purchase of existing agricultural water rights, about 222 acres, or less than one percent of the region's irrigated cropland in tillage rotation, might be removed from production.

Construction of the various facilities would block some stock-water sources. Roads and facilities would disrupt normal livestock grazing and watering patterns, although these same roads would aid in hauling water for livestock. Rustling would increase with population increase.

Some corral poles, fenceposts, mine timbers, pinyon nuts, and Christmas trees would be lost. Also, the potential production of these areas would be lost for the duration of the various projects. Demand for local timber may increase as a result of mining and associated activities.

The impacts summarized in this section would be important and possibly critical to affected individuals, but they would be minor on a regional basis.

3. SOCIOECONOMICS

The regional analysis of the impact of coal mining at the projected level assumes coal production of 12 mty (with mining employment of 1,040) by 1990 (table IV-6). No coal is mined in the region at present. Included also is development of the Allen-Warner Valley Energy System (chapter I). Most of the immediate social and economic impacts of coal mining and associated development will be centered in Kane and Garfield counties. These two counties are related economically to others in the region, though mainly to Washington and Iron Counties which contain regional trading centers. Indirect impacts of coal mining will be felt throughout the region.

Important basic economic activity in the region is concentrated in agriculture, mining, construction, manufacturing, transportation, trade, services, and government. Future economic growth and decline will be directly associated with changes in these basic sections. Thus, projections of the economic and demographic consequences of new economic activity, such as coal mining, are based on conditions assumed by each of these sectors. They are briefly highlighted here to provide a picture of plausible future regional economic conditions.

The agricultural sector serves both the region and markets beyond it. Farm employment was assumed to fall over time by about 1 percent per year. Because of healthy local economy, this rate of decline is less than has been assumed for the nation as a whole. The total of farm proprietorship plus wage and salary employment would decline from

Table IV-6. Coal production work force, southern region; low, projected, medium and high levels

Coal Production Scenarios	Locality	Production MTY 1980	Production MTY 1985	Production MTY 1990	Work Force 1985	Work Force 1990	Projected Work Force Residences
Low; 0-1 mty (No New Federal Actions)	Henry Mountains	None					
	Kaiparowits Plateau	None					
	Alton	None					
Projected level, 12 mty; includes Allen Warner Valley energy system; Blue, Kaiparowits No. 5, and Alton mines.	Henry Mountains	No detailed proposal					
	Kaiparowits Plateau		1.0	1.5	290	440	Kane Co. or Page
	Alton		5.0	10.5	290	600	Kane Co.
	Total		6.0	12.0	580	1,040	
Medium level, 29.3 mty, includes full production from Blue and Kaiparowits Nos. 1-5 and Alton mines and Allen Warner Valley energy system.	Henry Mountains	No detailed proposal					
	Kaiparowits Plateu		13.5	18.8	1,174	1,635	Garfield Co.
					2,739	3,815	Kane Co. or Page
	Alton		8.8	10.5	510	600	Kane Co.
	Total		22.3	29.3	4,423	6,050	
High level, 46.0 mty, includes middle level development and potential future development on other lands.	Henry Mountains		1.0	2.0	0	0	Garfield Co.
	Kaiparowits Plateau		17.8	33.5	2,580		
						4,855	Garfield Co.
					2,580	4,855	Kane Co. or Page
	Alton		9.6	10.5	560	600	Kane Co.
	Total		28.4	46.0	5,720	10,310	

[a]Work force estimates are based on 15 tons per worker-shift for underground mining and 75 tons per worker-shift for strip mining.

1,760 in 1975 to 1,560 in 1990. The future of the mining sector is bound up with potential coal production, so no significant change was assumed to occur in either the magnitude or county location of other types of mining employment. The construction sector was assumed to employ about 450 persons annually who could be considered part of the regional economic base. In addition, as much construction is undertaken to provide structures for residents of region, some of the sectors activity and employment was projected to increase with population in a manner similar to the expected national experience.

Employment in manufacturing has been about 80 percent basic (that is, producing goods locally for markets outside the region) and the remainder produces goods for the areas population. Substantial increases in the sectors basic component were assumed, somewhat in line with recent experience, and the remaining portion was assumed to continue to vary directly with regional population change. Transportation was assumed to increase in importance to the region, particularly if large-scale coal mining occurs. Trade and services are important sectors in the regional economy as much basic economic activity is generated by travel and tourism. It was assumed that tourist-related employment would increase by 3 percent per year to 1990. Finally, that part of government employment which is basic to the regional economy was assumed to remain relatively constant to 1990.

Changes in the above sectors induce further changes throughout the economy (this is the reason for denoting them "basic"). Such secondary changes can be traced in order to judge the total effects on the economy of any initial stimulus (such as an increase in coal mining employment). Thus, it was determined that each 1,000 jobs in the coal industry necessitates an additional 3 jobs in communications, 13 jobs in electricity, gas, and sanitation services, 37 jobs in transportation, and so on, to a total of 182 jobs in 17 employment sectors. Of course, such jobs are not necessarily to be filled from within the region alone; some of the employment impact of expanding coal production would occur outside the region. A portion of the added employment in these sectors was assumed to be provided from within the region (107 of the 182 jobs). This same estimation procedure was followed for each of the basic sectors described above.

A final type of employment must be mentioned. Some employment occurs simply to provide goods and services to the residents of the region (providing eductional services to area children is an example). Estimates of such employment were based on the regional sectors relation to national employment trends. Local projections, therefore, assume changing labor productivity, changing consumption patterns, and the effects of higher energy prices on the American economy, as these are portrayed in the work of the Bureau of Labor Statistics.

In many parts of the region, particularly in Kane and Garfield Counties, goods and services are not produced locally but are imported from elsewhere. Should high rates of population growth materialize owing to expanding coal mining, some of this importation should decline as new firms, finding a local market of sufficient size, begin operation. Otherwise, both the structure of ecomomic activity within the region and its relationship to the national economy will not change substantially during the next 15 years.

a. Population Projections

The social and economic impacts of expanded coal mining will occur in an area having a recent experience of relatively high rates of growth. But such impacts would exceed anything currently being encountered. The recent 1970 to 1975 growth (table IV-7), has occurred at rates above 3.5 and 4.3 percent per year respectively for the region and the combined area of Garfield and Kane Counties. Although these rates are above the corresponding 2.5 and 0.8 percent per year experiences of the State of Utah and of the nation, they involve small absolute numbers of persons in sparsely populated counties. As stated in chapter II, the sparsely populated character of the region established the kinds of impacts to be expected from expanding economic activity.

The impacts of the 12 mty coal production are evident in 1980 although coal production is not expected by that year. This is the result of assumed mine and coal-washing facility construction in Kane County (table IV-7). The larger volume of activity in Washington County associated with the Allen Warner-Valley energy system boosts projected 1980 county population to 23.1 thousand.

The stimulus to the Washington County economy evidenced in 1980 is in large part transitory. A comparison of tables II-36 and IV-7 shows an increase in population by 1985 of about 400 persons. That number is further reduced over time, and by 1990 the difference between no new coal mining (low level scenario) projected levels is negligible in Washington County. The "construction boom" nature of the impact yields a relatively large out-migration in an otherwise growing region.

Kane County will contain both the sites of employment and the residences of miners for coal production from the Kaiparowits Plateau and Alton mines in 1985 and 1990. The large direct increases in jobs would transform the Kane County economy between 1980 and 1985. By 1985 the county would be adjusting to accomodate a population almost double that expected with no mining. The resulting net in-migration alone over the 5-year interval would approximately equal the total 1980 population.

The larger population and increased in-migration in Garfield County in the projected 12 mty production are consequences of induced and secondary economic expansion. These impacts reflect the importance of Panquitch as a trading center, and result in localization of the Garfield County expansion in the Hatch-Panguitch area. Similarly, projected increases in the Beaver-Iron County area occur because Cedar City is the regional service center. Impacts would be localized at Cedar City. Appreciable impacts of the 12 mty production probably would not occur in the Tropic-to-Escalante regions of Garfield County.

Table IV-7. Population and components of change (thousands of persons)

County	1970 Population	Interval Components of Change		1975 Population	Interval Components of Change		1980 Population	Interval Components of Change		1985 Population	Interval Components of Change		1990 Population
		Natural Increase	Migration		Natural Increase	Migration		Natural Increase	Migration		Natural Increase	Migration	
Garfield	3.2	0.2	+0.1	3.4	0.2	+0.3	3.9	0.3	+1.1	5.3	0.4	+0.4	6.1
Kane	2.4	0.1	+1.0	3.6	0.3	+0.4	4.2	0.3	+4.2	8.8	0.8	+2.5	12.1
Garfield and Kane	5.6	0.3	+1.1	7.0	0.5	+0.6	8.1	0.6	+5.4	14.1	1.2	+2.3	18.2
Beaver and Iron	16.0	1.4	+1.0	18.4	1.7	+0.9	21.0	1.6	+0.7	23.2	1.4	+0.1	24.6
Washington	13.7	1.2	+2.1	17.0	2.2	+3.9	23.1	2.4	-2.3	23.1	1.7	-0.7	24.1
Beaver, Iron, Washington	29.6	2.7	+3.1	35.5	3.9	+4.7	44.1	4.0	-1.7	46.4	3.0	-0.6	48.8
Total, Five County	35.2	2.9	+4.3	42.4	4.4	+5.3	52.2	4.6	+3.7	60.5	4.2	+2.3	67.0

(Detail may not add to totals because of independent rounding.)

Source: 1970; U.S. Census of Population. Projection Years and Intervals for Counties; UPED Model Projections, Bureau of Economic and Business Research, University of Utah.

b. Comparison of Impacts, Projected Level to Low Level

In the following pages, the important impacts of expanded coal mining will be discussed. Magnitudes will be derived by comparing the two cases. The focus will be on the age composition of the population, housing requirements, labor market conditions, and employment changes.

1. Age Composition

Higher growth rates not only increase the total size of the population but also induce significant alterations in the pattern of distribution over the various age groups (table IV-8). Such alterations are most pronounced in Kane County because of the induced 1980 to 1985 net migration is very large--approximately the magnitude of the 1980 population.

The willingness of persons to move in search of economic opportunity varies with age. Hence, in Kane County in 1985, the 5- to 14-year age group approximately doubles as the population increases. The more mobile 15- to 24-year-olds increase from 740 to 1,830, or 2 1/2 times. The 25- to 44-year-old age group roughly doubles, while the older workers and those of retirement age increase by about 50 percent in the regional analysis case.

Differences in age composition can have major consequences. For instance, a disproportionate expansion in the number of women of child-bearing age results in more children under 5 years of age in 1990 in the regional analysis as compared to growth with no new mining (low level scenario). Those of school age (the 5- to 14-year age group) reach 2,340 in Kane County, more than double the 1,020 expected under the no mining assumptions. A 50 percent increase in school age population is predicted, excluding mining, by 1990. If Kane County coal production reaches the projected level, the resulting school age population will be 3 1/2 times greater than currently.

The same character of change, but with much smaller magnitudes, will occur in Garfield County in the remainder of the region. The numbers involved, especially for Garfield County, are larger than at present, but demonstrate the limited impacts owing to the projected coal production and associated activity.

A relatively small increase is expected in the number of the elderly (300 more than under low level scenario by 1990) in Kane County. But the elderly can be adversely affected by rapid economic growth conditions. While economic expansion will increase total and average incomes in the region, the elderly often have fixed incomes and are vulnerable to the adverse effects of rising prices associated with strong economic expansion. To the extent an elderly person does not have a marketable skill or an ownership position in a local commercial or land enterprise, he will face a deterioration in cash flow as prices,

Table IV-8.--Projections of population by age group; low level and projected level scenarios; Counties of Garfield and Kane and remainder of Southern Utah Coal EIS Region

[Population in thousands]

Age group	1970	1970	1980 Low level	1980 Projected level	1985 Low level	1985 Projected level	1990 Low level	1990 Projected level
				Garfield County				
0-14	.258	.31	.41	.41	.48	.57	.49	.62
5-14	.780	.64	.62	.62	.80	.97	.98	1.19
15-24	.494	.79	.86	.86	.74	.96	.73	.90
25-44	.631	.62	.90	.90	1.27	1.57	1.63	2.09
45-64	.685	.67	.67	.67	.66	.72	.67	.76
65+	.309	.37	.42	.42	.47	.52	.49	.55
Total	3.157	3.41	3.89	3.90	4.42	5.31	4.99	6.10
				Kane County				
0-4	.244	.32	.48	.48	.48	.89	.47	1.26
5-14	.569	.69	.70	.72	.83	1.64	1.02	2.34
15-24	.331	.86	.84	.86	.74	1.83	.78	2.04
25-44	.498	.74	1.14	1.16	1.42	2.86	1.68	4.44
45-64	.538	.62	.61	.61	.60	.92	.68	1.24
65+	.241	.34	.38	.38	.42	.66	.44	.78
Total	2.421	3.57	4.15	4.23	4.49	8.80	5.06	12.09
				Remainder of Southern Utah Coal EIS Region				
0-4	2.980	3.85	4.86	5.04	4.79	4.91	4.31	4.29
5-14	6.315	6.48	7.55	7.94	8.98	9.10	9.62	9.64
15-24	6.505	8.32	7.73	8.38	6.97	6.91	7.59	7.59
25-44	5.609	7.54	11.32	11.98	13.89	14.32	15.47	15.58
45-64	5.185	5.51	5.97	5.97	5.78	5.87	5.93	6.02
65+	3.052	3.76	4.64	4.74	5.29	5.28	5.67	5.63
Total	29.646	35.45	41.89	44.05	45.70	46.38	48.57	48.76

[Details may not add to totals because of independent rounding.]

Source: 1970: U.S. Census of Population; 1975 and projected years: UPED Model Projections, Bureau of Economic and Business Research, University of Utah.

fees, and taxes paid in the local economy increase faster than money income. Moreover, the older person has less time in which to realize a return on an investment in retraining or skills acquisition. Thus, he is less likely to take advantage of expanded area job opportunities. The large increase in area population (largely newcomers) with resultant change in the age composition of the local population will erode the political basis by which the elderly can work to alleviate their economic distress.

Changes over time are anticipated in the age composition of the population. (table IV-9) One important consequence of such changes is the decreasing number of persons who participate but little in the labor force for every person who does (expressed as the "dependency ratio"). In Garfield County, for example, 35.1 percent of the population in 1970 was 0-15 years of age, and 9.8 percent, 65 years of age or older (in all, 44.9 percent of the county total). Those in the traditional working years were 55.1 percent of county population. The dependency ratio (.449 divided by .551) was .82. The corresponding U.S. figure was 0.67. The ratio will fall as relatively more persons are employed, and hence, should fall, as coal mining increases in Garfield and Kane Counties. The current ratio of nonworking to working persons in the area helps explain the relatively low per capita incomes found there.

Changes in dependency ratios are paralleled by changes in median age (that at which half the population is younger and half older). It has been increasing rapidly for the Nation and the State but has been falling for the counties of Garfield and Kane as a result of in-migration. Continued in-migration will decrease the proportion of the population in the traditional retirement years. But the strong expansion of the projected coal development will further decrease the percent 65 and over (in 1990, 6.5 percent instead of 8.6 percent of the population). As a consequence, the special needs of persons in this age group may be given little weight in the process of responding to burgeoning requirements for schools, single-family housing, sanitation systems, etc.

2. Housing

Expected population impact in Kane County amounts to slightly over 7,000 persons by 1990 a difference in population between the projected level and the low level (no Federal action) of nearly three times the entire 1970 Kane County population. This population will require over 1,900 more dwelling units than in low level scenario case, a total requirement much greater than the 1970 Kane County stock of occupied housing. Smaller impacts are expected in Garfield County and the remainder of the region (table IV-10). For housing projection purposes, the implications of large in-migration for average household size should be noticed, especially in Kane County. Out-migration prior to 1970 decreased average household size to an abnormally low level.

Table IV-9. Characteristics of the age composition; low and projected levels, with comparisons to the United States and State of Utah

	Garfield County		Kane County		Remainder of Southern Utah Coal EIS Region		State of Utah	United States
	Low level	Projected level	Low level	Projected level	Low level	Projected level		
1970								
Percent of Population 0-15	35.1		35.5		34.0		35.5	30.4
Percent of Population 65+	9.8		10.0		10.3		7.3	9.8
Dependency Ratio	.82		.84		.79		.75	.67
Median Age	26.6		27.5		23.1		23.1	28.0
1975								
Percent of Population 0-15	30.4		30.7		31.2		33.0	27.1
Percent of Population 65+	11.0		9.5		10.6		7.4	10.5
Dependency Ratio	.71		.67		.72		.68	.60
Median Age	24.5		24.0		24.0		23.9	28.8
1980								
Percent of Population 0-15	28.6	28.6	30.3	30.2	31.3	31.1	31.5	24.3
Percent of Population 65+	10.9	10.9	9.2	9.1	11.1	10.8	7.4	11.2
Dependency Ratio	.66	.65	.65	.65	.74	.72	.64	.55
Median Age	25.6	25.6	25.5	25.5	25.8	25.6	25.0	30.2
1985								
Percent of Population 0-15	30.3	30.2	30.8	30.4	31.7	31.7	30.9	23.7
Percent of Population 65+	10.7	9.8	9.4	7.5	11.6	11.4	7.6	11.7
Dependency Ratio	.70	.67	.67	.61	.76	.76	.63	.55
Median Age	26.9	26.2	27.1	25.2	27.4	27.5	26.6	31.5
1990								
Percent of Population 0-15	30.9	31.2	30.9	31.3	30.4	30.3	29.2	23.8
Percent of Population 65+	9.9	9.0	8.6	6.5	11.7	11.6	7.8	12.1
Dependency Ratio	.69	.67	.65	.61	.72	.72	.59	.56
Median Age	28.1	27.6	28.1	26.4	28.9	29.2	28.2	32.8

Source: 1970: U. S. Census of Population or derived therefrom.
United States: Bureau of the Census Current Population Reports, P-25, #643 and 704, Series II.
Utah: Office of State Planning Coordinator, Alternative Future Zero (1974).
Counties: UPED Model Projections, Bureau of Economic and Business Research, University of Utah.

Table IV-10. Housing requirements; low and projected level estimates and projections with comparisons to the State of Utah

		Garfield County		Kane County		Remainder of Southern Utah Coal EIS Region		State of Utah
		Low level 0-1 mty	Projected level 12 mty	Low level 0-1 mty	Projected level 12 mty	Low level 0-1 mty	Projected level 12 mty	
1970	Percent of Population in Dwelling Units	100		100		96.3		97.3
	Occupied Dwelling Units (in thousands)	.923		.718		8.403		297.934
	Average Household Size	3.42		3.37		3.40		3.46
1975	Occupied Dwelling Units (in thousands)	.97		.99		9.85		349.53
	Average Household Size	3.51		3.61		3.47		3.36
1980	Occupied Dwelling Units (in thousands)	1.14	1.15	1.19	1.21	12.17	12.74	428.76
	Average Household Size	3.40	3.40	3.48	3.48	3.31	3.33	3.23
1985	Occupied Dwelling Units (in thousands)	1.33	1.57	1.33	2.49	13.65	13.87	496.40
	Average Household Size	3.32	3.38	3.37	3.54	3.22	3.22	3.11
1990	Occupied Dwelling Units (in thousands)	1.50	1.82	1.52	3.48	14.79	14.87	548.12
	Average Household Size	3.31	3.35	3.34	3.48	3.16	3.16	3.02

Sources: 1970: U.S. Census of Population.
Other Years: State of Utah: Alternative Future Zero, Office of State Planning Coordinator (1974).
Counties: UPED Model Projections, Bureau of Economic and Business Research, University of Utah.

Since 1970, in-migration has caused it to increase, out, with economic and demographic changes arising from coal mining, average household size will begin to decline once again. It will remain, however, higher than the corresponding figure for the State throughout the projection period.

Single-family homes predominate in the area. However, much of the projected housing demand would be met by the use of mobile homes. This type of shift has several implications for the communities. The types of services demanded may change with different lifestyles that may be associated with different housing preferences. These types of changes are difficult to anticipate. The financial structure of the community might be adversely affected since tax yields are lower on mobile homes than single-family homes.

3. Labor Market

As a result of the changing age composition of the population, the number of jobs available regionally should grow more rapidly than will population (table IV-11). This is also owing to changes in the rates at which persons will participate in the labor force (low in the area currently), decreases in the numbers of persons who work part-time or hold more than one job, and a decreasing unemployment rate. All are consequences of regional economic growth.

The low growth anticipated for proprietorships (table IV-11) is a reflection of the extraordinarily high rates of self-employment currently observed within the region. In the region, 18.9 percent of all employment is accounted for by proprietorships. The corresponding State figure is 9.4 percent. Some of this difference is the result of the unusual regional importance of agriculture, and some is due to differences in the regional mix of industries. But high rates of proprietorship are found in labor markets with a history of relatively restricted job opportunities. Accordingly, the projections for the low and projected levels show decreases in rates of proprietorship for all sectors other than farming, from 1.6 times the 1975 State experience to a factor of 1.3 by 1990.

Variations between the region and the State also occur in the rates at which persons participate in the labor force. Where job opportunities are limited, a lower rate of participation is not unusual. Both the low and projected level analysis indicate expanded job opportunities, so regional labor force participation rates should increase over the projected period until about equal to projected 1990 State rates.

The changes over the projection intervals in assumed labor force participation rates, rates of occurrence of proprietorship by sector, unemployment rates, and the projected changes in the age composition of the population have two immediate implications. First, the current population has some capacity to supply increasing amounts of

Table IV-11. Projected expansion in regional population and employment; low and projected levels (in thousands)

	1975	Interval Growth Rate (Percent per year)	1980	Interval Growth Rate (Percent per year)	1985	Interval Growth Rate (Percent per year)	1990
Low Level							
Population	42.43	(3.25)	49.93	(1.80)	54.62	(1.41)	58.62
Labor Force	16.04	(3.32)	18.94	(1.89)	20.82	(2.09)	23.11
Jobs (Full and Part Time)	15.70	(3.66)	18.85	(2.20)	21.04	(2.09)	23.36
Proprietor	3.05	(1.70)	3.32	(0.77)	3.45	(0.46)	3.53
Wage and Salary	12.66	(4.09)	15.53	(2.50)	17.60	(2.39)	19.83
Projected Level							
Population	42.43	(4.14)	52.19	(2.96)	60.50	(2.03)	66.96
Labor Force	16.04	(4.31)	19.90	(3.12)	23.26	(2.70)	26.62
Jobs (Full and Part Time)	15.70	(4.64)	19.80	(3.44)	23.52	(2.69)	26.91
Proprietor	3.05	(2.70)	3.49	(1.11)	3.69	(0.69)	3.82
Wage and Salary	12.66	(5.07)	16.31	(3.91)	19.83	(3.04)	23.09

Source: UPED Model Projections, Bureau of Economic and Business Research, University of Utah.

labor as job opportunities increase. This however, is limited by the small numbers of people currently residing within commuting distance of the areas of immediate impact. Second, the relative increase in jobs and the expected relative expansion in high wage employment sectors will increase personal income per person relative to the State, to other regions, to current conditions in the region itself.

4. Employment

Coal mining (projected level) will expand Kane County's economic base by an amount 20 percent greater than total 1975 nonagricultural employment (1,040 to 857). This magnitude of change will restructure the economy of Kane County. But impacts are not limited to that county only. There are appreciable direct and indirect consequences of the associated construction activity in Washington County, and important effects, both positive and negative, on the government, trading, and service sectors outside the immediate Kane and Garfield County areas.

Magnitudes and composition of regional employment are important aspects of the differences between the low and projected level growth experiences (table IV-12). This is well illustrated by the agriculture sector. Agricultural employment will decline in both cases, but the fact that there will be more people in the region for the sector to serve yields slightly less overall decrease in the case of the regional analysis level of production.

Changes in employment composition are clearly indicated by percentage (table IV-12). Again, using agriculture as an example, in 1975 it offered approximately 12 percent of five-county area jobs. By 1990, it will account for approximately 7 percent. Manufacturing will grow more rapidly in both cases over the 15-year time period than will the population itself. The 1975 to 1990 regional population increases are 38 percent and 58 percent respectively for the and projected levels. The corresponding changes for manufacturing employment are 121 percent and 124 percent.

The economic impact on Garfield County of expanding coal production consists of relatively small employment growth when the low level is compared to the projected level analysis (table IV-13). The expansion is concentrated in the transportation, trade, financial, and service sectors.

Kane County, on the other hand, will experience much larger impact, four times more jobs by 1990 at the projected level than in 1975, and 2 3/4 times more than at the low level (table IV-14).

The introduction of large-scale economic enterprises and a more than 400 percent increase in population between 1975 and 1990 will result in some change in economic activity in the broader region. Employment in the trade and services sectors will expand in Kane County

Table IV-12. Employment by sector; low and projected levels estimated for 1975, projected for 1980, 1985 and 1990 for the Southern Utah Coal EIS region (in thousands)

	1975	1980		1985		1990	
		Low Level (0-1 mty)	Projected Level (12 mty)	Low Level (0-1 mty)	Projected Level (12 mty)	Low Level (0-1 mty)	Projected Level (12 mty)
Agriculture	1.86	1.82	1.82	1.76	1.78	1.71	1.73
Mining	.42	.42	.42	.42	1.02	.42	1.49
Construction	1.06	1.17	1.54	1.29	1.54	1.40	1.60
Manufacturing	1.09	1.52	1.53	1.96	1.99	2.40	2.44
TCU[a]	.71	.82	.86	.90	1.16	.96	1.28
Trade	4.12	5.24	5.44	5.78	6.28	6.28	7.01
FIRE[b]	.55	.72	.76	.85	.95	.98	1.13
Services	2.32	2.99	3.09	3.51	3.77	4.03	4.43
Government	3.59	4.15	4.33	4.57	5.02	5.16	5.81
Total	15.70	18.85	19.80	21.04	23.52	23.36	26.91
		Percentage Allocation					
Agriculture	11.8	9.6	9.2	8.4	7.6	7.3	6.4
Mining	2.7	2.2	2.1	2.0	4.3	1.8	5.5
Construction	6.7	6.2	7.8	6.1	6.5	6.0	5.9
Manufacturing	6.9	8.0	7.7	9.3	8.5	10.3	9.1
TCU[a]	4.5	4.4	4.4	4.3	5.0	4.1	4.7
Trade	26.2	27.8	72.5	27.5	26.7	26.9	26.0
FIRE[b]	3.5	3.8	3.8	4.1	4.0	4.2	4.2
Service	14.8	15.8	15.6	16.7	16.0	17.3	16.5
Government	22.8	22.0	21.9	21.7	21.3	22.1	21.6

(Details may not add to totals because of independent rounding.)

[a]Transportation, Communication and Utilities

[b]Finance Insurance and Real Estate

Source: UPED Model Projections, Bureau of Economic and Business Research, University of Utah.

Table IV-13. Garfield County Employment by sector; full and part time and percentage allocation; low and projected levels; estimated for 1975 and projected for 1980, 1985, and 1990 (in thousands)

	1975	1980		1985		1990	
		Low Level (0-1 mty)	Projected Level (12 mty)	Low Level (0-1 mty)	Projected Level (12 mty)	Low Level (0-1 mty)	Projected Level (12 mty)
Agriculture	.28	.27	.27	.26	.26	.25	.25
Mining	.06	.06	.06	.06	.06	.06	.06
Construction	.09	.12	.12	.13	.18	.14	.17
Manufacturing	.25	.26	.26	.34	.34	.42	.43
TCU[a]	.04	.04	.04	.05	.06	.06	.08
Trade	.32	.38	.38	.44	.59	.50	.71
FIRE[b]	.02	.03	.03	.04	.06	.04	.08
Services	.32	.37	.37	.43	.48	.49	.58
Government	.29	.33	.33	.38	.43	.44	.51
Total	1.66	1.85	1.86	2.11	2.48	2.41	2.88
			Percentage Allocation				
Agriculture	16.6	14.5	14.4	12.3	10.5	10.4	8.8
Mining	3.3	3.0	3.0	2.6	2.3	2.3	1.9
Construction	5.7	6.5	6.6	6.2	7.5	6.0	6.0
Manufacturing	14.8	13.9	13.8	15.9	13.7	17.6	15.0
TCU[a]	2.2	2.4	2.4	2.4	2.6	2.4	2.6
Trade	19.3	20.7	20.6	20.6	23.9	20.7	24.8
FIRE[b]	1.4	1.6	1.6	1.8	2.6	1.9	3.0
Service	19.4	19.8	19.8	20.2	19.5	20.5	20.1
Government	17.4	17.7	17.7	18.0	17.4	18.3	17.8

(Details may not add to totals because of independent rounding.)

[a]Transportation, Communication and Utilities

[b]Finance Insurance and Real Estate

Source: UPED Model Projections, Bureau of Economic and Business Research, University of Utah.

Table IV-14. Kane County employment by sector; full and part time and percentage allocation; low and projected levels; estimated for 1975 and projected for 1980, 1985 and 1990 (in thousands)

	1975	1980		1985		1990	
		Low Level (0-1 mty)	Projected Level (12 mty)	Low Level (0-1 mty)	Projected Level (12 mty)	Low Level (0-1 mty)	Projected Level (12 mty)
Agriculture	.18	.18	.18	.17	.18	.17	.18
Mining	.00	.00	.00	.00	.60	.00	1.07
Construction	.07	.08	.10	.09	.28	.10	.26
Manufacturing	.08	.09	.09	.11	.13	.14	.17
TCU[a]	.04	.05	.05	.05	.17	.06	.22
Trade	.25	.30	.31	.33	.72	.38	1.00
FIRE[b]	.02	.03	.03	.04	.11	.04	.17
Services	.26	.30	.30	.35	.52	.40	.72
Government	.22	.27	.28	.31	.56	.37	.83
Total	1.12	1.30	1.33	1.45	3.27	1.67	4.63
			Percentage Allocation				
Agriculture	16.1	13.4	13.1	11.7	5.5	10.0	4.0
Mining	0.2	0.2	0.1	0.1	18.3	0.2	23.1
Construction	6.1	6.0	7.2	5.9	8.4	6.1	5.7
Manufacturing	6.9	7.0	6.8	7.8	4.1	8.5	3.7
TCU[a]	3.4	3.7	3.8	3.6	5.1	3.5	4.8
Trade	22.0	23.2	23.0	23.0	21.9	22.8	21.7
FIRE[b]	2.2	2.5	2.5	2.5	3.4	2.7	3.8
Service	23.0	23.2	22.8	23.8	15.9	24.0	15.5
Government	20.1	20.8	20.6	21.5	17.3	22.4	17.8

(Details may not add to totals because of independent rounding.)

[a]Transportation, Communication and Utilities

[b]Finance Insurance and Real Estate

Source: UPED Model Projections, Bureau of Economic and Business Research, University of Utah.

relative to the projected growth in St. George (Washington Co.) and Cedar City (Iron Co.) as Kane and Garfield Counties develop higher-level population and industrial service activities (tables IV-14, IV-15). Still, it cannot be argued that the economy of the entire region (unlike that of Kane County alone) will be restructured because of the growth levels of the projected coal production of 12 mty.

c. Municipal Services

Assuming 12 mty coal production, the population impacts resulting from increases in employment differ significantly between Kane and Garfield Counties. A comparison of the low and projected levels shows small differences in community populations by 1990 in most of the towns in Garfield County. The resultant impacts on municipal services are therefore, relatively small. In Kane County, the comparison indicates projected population changes which are typical of "boom-town" growth rates (table IV-16).

The impacts on municiapl services include projected service expansion needs and the major capital costs. Most facility improvements require a lead time of 1 to 2 years for planning and construction. These are not reflected in the summaries. The expansion needs and costs are related to the coal production schedules.(Table IV-17)

In Garfield County the communities can generally handle the growth generated by the projected level of coal production. The Kane County communities summaries indicate substantial demand for increased municipal services. Except for Kanab, the suggested expansion of services apply to medium and high production levels as well. The additional growth generated by increases in coal production is assumed to reside in a new town, or workers will be commuting from Page, Arizona (fig. I-2).

d. Sources of Revenue

The years in which large capital expenditures are reflected do not have large offsetting sources of revenue which are built into the financial structure of the state and local governments. The community impact studies generally indicate that operation and maintenance costs for a community are covered as the population increases; the increasing costs are off-set by increasing revenues. The problem is one of funding improvements which need to be on-line prior to the arrival of new residents.

1. <u>Taxation</u>

Taxes generating most of the revenue to counties and local communities include: 1) The general property tax used for school districts, municipalities, counties, and special districts; 2) Sales and

Table IV-15. Beaver, Iron and Washington County employment by sector; full and part time and percentage allocation; low and projected levels; estimated for 1975 and projected for 1980, 1985 and 1990 (in thousands)

	1975	1980		1985		1990	
		Low Level (0-1 mty)	Projected Level (12 mty)	Low Level (0-1 mty)	Projected Level (12 mty)	Low Level (0-1 mty)	Projected Level (12 mty)
Agriculture	1.40	1.37	1.38	1.33	1.33	1.29	1.29
Mining	.36	.37	.37	.36	.36	.36	.36
Construction	.90	.97	1.32	1.07	1.08	1.16	1.16
Manufacturing	.76	1.17	1.18	1.52	1.52	1.84	1.83
TCU[a]	.63	.73	.76	.79	.93	.85	.98
Trade	3.55	4.56	4.75	5.01	4.97	5.40	5.30
FIRE[b]	.50	.66	.69	.78	.77	.90	.88
Services	1.74	2.32	2.42	2.74	2.77	3.14	3.13
Government	3.07	3.55	3.72	3.88	4.02	4.35	4.47
Total	12.92	15.69	16.60	17.48	17.76	19.28	19.40
Percentage Allocation							
Agriculture	10.9	8.7	8.3	7.6	7.5	6.7	6.7
Mining	2.8	2.3	2.2	2.1	2.1	1.9	1.9
Construction	6.9	6.2	8.0	6.1	6.1	6.0	6.0
Manufacturing	5.9	7.5	7.1	8.7	8.5	9.5	9.4
TCU[a]	4.9	4.7	4.6	4.5	5.2	4.4	5.1
Trade	27.5	29.0	28.6	28.6	28.0	28.0	27.3
FIRE[b]	3.9	4.2	4.2	4.5	4.4	4.6	4.5
Service	13.5	14.8	14.6	15.7	15.6	16.3	16.2
Government	23.8	22.6	22.4	22.2	22.6	22.6	23.0

(Details may not add to totals because of independent rounding.)

[a]Transportation, Communication and Utilities

[b]Finance Insurance and Real Estate

Source: UPED Model Projections, Bureau of Economic and Business Research, University of Utah.

Table IV-16. Community population projections at the projected level

	Total Population Projection			Population Increase	
	1980	1985	1990	1985	1990
Garfield County					
Antimony	148	195	223	27	43
Boulder	176	227	258	28	33
Cannonville	144	253	296	89	111
Escalante	772	1,125	1,301	248	312
Hatch	152	208	239	35	44
Henrieville	195	310	360	88	111
Panguitch	1,553	1,886	2,143	125	156
Tropic	425	686	801	203	256
Kane County					
Alton	55	372	500	323	454
Glendale	173	738	968	581	816
Kanab	3,041	4,239	5,112	904	1,270
Orderville	368	1,007	1,276	678	952

Table IV-17. Projected community needs; year and cost of installation at all four production levels. The total needs at higher levels include the needs listed at lower levels.

County/Community	PRODUCTION LEVELS No New Federal Action (0-1 mty)	Projected Level (12 mty)	Medium Level (29.3 mty)	High Level (46.0 mty)
Garfield County				
Antimony	None	1980 Improve Fire Dept. $45,000	1980 Upgrade Solid-waste disposal 1985 Add to Administrative Staff 1990 Add to Office Space Park Dept. Improve Water System; 1980 - $50,000 1990 - $197,000	1985 Expand Police Force 1980 - $60,000 1985 - $30,000 1990 - $589,000
Boulder	None	1980 Improve Fire Dept. 1990 Improve Water System 1980 - $45,000 1990 - $77,000	1985 Add to Administrative Staff Park and Cemetary Development Add to Office Space	1985 Improve Police Service 1990 Solid Waste Disposal 1980 - $45,000 1985 - $83,000 1990 - $818,000
Cannonville	None	1980 Improve Fire Dept. 1980 - $45,000	1980 Improve Fire Dept. Add to Administrative Staff Add to Office Space Expand Police Department Add to Office Space 1990 Water System 1980 - $97,000 1985 - $109,000 1990 - $930,000	1985 Solid Waste Disposal 1980 - $241,000 1985 - $184,000 1990 -
Escalante	None	1980 Added Staff and Office Space 1980 - $68,000	1980 Added Staff and Office Space Improve Fire Department Improve Police Services Improve Cemetary 1985 Add to Office Space Improve Parks, Library Ambulance Service 1990 Water System 1980 - $274,000 1985 - $296,000 1990 - $924,000	1985 Improve Airport 1980 - $446,000 1985 - $1,083,000 1990 - $5,699,000

Table IV-17. (continued)

County/Community	No New Federal Action (0-1 mty)	PRODUCTION LEVELS Projected Level (12 mty)	Medium Level (29.3 mty)	High Level (46.0 mty)
Garfield County Hatch	None	1980 Improve Fire Department 1980 - $45,000	1980 Improve Fire Department Additional Staff 1985 Office Space Parks and Cemetary Development Solid Waste Disposal Water System 1980 - $45,000 1985 - $73,000 1990 - $375,000	Greater Expansion of lower level services 1980 - $54,000 1985 - $109,000 1990 - $996,000
Henrieville	None	1980 Improve Fire Department 1990 Water System 1980 - $45,000 1990 - $98,000	1980 Add to Administrative Staff and Office Space Improve Fire and Police Service 1990 Water System 1980 - $97,000 1985 - $113,000 1990 - $1,096,000	1985 - Ambulance Service Solid Waste Disposal 1980 - $196,000 1985 - $223,000 1990 - $2,773,000
Panquitch	1990 Sewage Disposal System 1990 - $415,000	1985 Office Space 1990 Sewage Disposal System 1985 - $116,000 1990 - $425,000	1980 Add to Staff and Office Space 1985 Ambulance Service Solid Waste Disposal Airport Improvement 1990 Sewage Disposal System 1980 - $140,000 1985 - $202,000 1990 - $560,000	1985 Library Improvement Water System Improvement 1980 - $167,000 1985 - $416,000 1990 - $1,780,000
Tropic	None	1985 Office Space 1990 Water System 1985 - $42,000 1990 - $261,000	1980 Office Space Improve Fire and Police Service Cemetary Improvement 1985 Ambulance Service 1990 Water System 1980 - $165,000 1985 - $164,000 1990 - $2,466,000	1985 Library Park Department Solid Waste Disposal 1980 - $211,000 1985 - $448,000 1990 - $6,058,000

Table IV-17. (continued)

County/Community	PRODUCTION LEVELS No New Federal Action (0-1 mty)	Projected Level (12 mty)	Medium Level (29.3 mty)	High Level (46.0 mty)
Kane County				
Alton	None	1980 Water System Fire Department 1985 Sewage Disposal System 1980 - $489,000 1985 - $306,000	Same as projected level	Same as projected level
Glendale	None	1980 Stage II Sewer Improvement Park Department Improve Fire Department Expand Street Maintenance Water System (No Cost Estimated available) 1980 - $303,000 1985 - $35,000	Same as projected level	Same as projected level
Kanab	1980 Office Space Park Development Sewage Disposal System Street Maintenance Equipment 1980 - $478,000	1980 Water System Improvement (no cost estimates available) Expand Police Department 1985 Improve Fire Department 1980 - $490,000 1985 - $72,000	Expansion of lower level services 1980 - $496,000 1985 - $272,000	Same as Medium level
Orderville	None	1980 Stage II Sewer Improvement Project Park and Cemetary Development 1985 Water System 1980 - $257,000 1985 - $244,000	Same as projected level	Same as projected level

use tax--local option to counties and cities of 3/4 percent of purchase price returned to local units imposing the tax; 3) Individual income and Corporation-Franchise Tax allocated to the Uniform School Fund: distribution to local districts under minimum school program; and 4) Other taxes collected from Liquor Control profits and Motor Vehicle Registration, etc. These sources are seldom sufficient to finance municipal services necessary to accommodate rapid population growth. The principal problem is one of geographic imbalance between anticipated tax revenue and population impact.

2. Bonding

Local non-monetary fiscal methods used to finance large expenditures for municipal services includes local government bonding. The two methods of bonding most commonly used are general obligation bonds and revenue bonds, the issuance and amount of the former being restricted by law.

General obligation bonds are repaid from a property tax on all real property within the taxing jurisdiction. All general obligation bonds must be authorized by a referendum election. Interest costs associated with this method of borrowing are generally the lowest going rates available since the full faith and credit of the municipality are behind the bonds.

When rapid growth is in progress, the lag between the need for debt capital and the generation of debt capital bonding creates uncertainty in planning. Likewise, uncertainty with respect to planned industrial expansion and the duration of industrial activity often creates risk and high borrowing costs. Bonding limits for communities in Garfield and Kane Counties are shown in tables IV-18 and IV-19.

3. Education

Garfield County School District--By 1990 the Garfield School District would be serving about 310 more students at the projected level than at the low level. In terms of full-time teacher equivalents (FTE) this would mean an additional 12.5 teachers. Of the existing facilities, only one would require additioal classrooms. The capital cost would be about $225,000.

Kane County School District--An additional 1,100 students would have to be served by 1990 at the projected level. About 37 FTE teachers would be needed. Most of the facilities are relatively new; however, an additional 21 classrooms plus support facilities would be needed to accommodate the increase in students. This is assuming that the Kanab schools build the necessary facilities to handle the increase under the assumptions of growth at the low level (no Federal action). The expansion cost of the Kanab schools is estimated to be $3,187,000. There is no estimate available on the cost of an additional 21 classrooms.

Table IV-18.--Bonding limit - government entities in Garfield County

Government entity	Bonding capacity based on 1976 assessed values: Estimated fair market value	Maximum bonding limit	Bonding limit on a percent of fair market value
Antimony	1,271,500	152,580	12
Boulder	1,626,000	195,120	12
Cannonville	438,250	52,590	12
Escalante	3,699,500	443,940	12
Hatch	980,000	117,600	12
Henriville	565,750	67,890	12
Panguitch	8,642,000	1,037,040	12
Tropic	1,645,500	197,460	12
Garfield County	68,581,500	1,371,630	2
Garfield County School District	68,581,500	2,743,260	4

Table IV-19 Bonding Limit - government entities in Kane County

Government Entity	Bonding Capacity Based on 1975 Assessed Values: Estimated Fair Market Value	Maximum Bonding Limit	Bonding Limit on a Percent of Fair Market Value
Alton	309,150	37,000	12
Glendale	839,070	101,000	12
Orderville	1,680,840	202,000	12
Kanab	11,232,580	1,348,000	12
Kane County	36,900,635	738,000	2
Kane County School District	36,900,635	1,476,000	4
Long Valley Sewer District		361,000[1]	

[1] Estimate based on financing plans in the Long Valley Sewer Improvement District's Facilities Plan - Step 1.

4. Finance

Finance cannot be projected with accuracy because of fluctuations in assessed valuation, mill levies, and weighted pupil units (WPU's). State, local and Federal governments are the three basic sources of funding for Utah Public Schools.

State support is based on a support equalization program. Each school district in Utah receives WPU's according to size, need, and other variables. The dollar value of the SPU has been going up each year for the last 3 years at approximately 10 percent per year. If this pattern holds true, school officials could project a yearly increase in the value of the WPU in the 8 to 10 percent range.

Local funds are accrued by multiplying the school district mill levy by the assessed valuation of the county or geographical area it serves. The best plan for determining the level of local support for the school system would be to make the crucial decisions regarding capital outlay expenditures and arrive at a dollar figure estimate. The county assessed valuation could then be computed for the construction period based on the activities of the development companies at that point. The difference between the estimated need and the projected revenues would have to be made up from bonding, State funds, or other sources.

Federal funds will not play as important a part in financing the projected growth in the school districts as local and State funds.

e. Out-of-State Areas With Impact Potential

The coal mining potential in the Kaiparowits region is close to the town of Page, Arizona, which is located just south of the Utah-Arizona border near Lake Powell.

The town of Page was created by the Bureau of Reclamation in 1957 to house workers constructing Glen Canyon Dam. The population peaked in 1962 at 6,200 and then declined to about 1,000 in the next 4 years. It boomed a second time in 1970, when construction began on the Navajo generating station. Population peaked at more than 9,000 in early 1975. The Bureau turned over operation of the town to locally elected officials in March 1975, as a result of Public Law 93-493. Seventeen square miles of land, along with all municipal services, were transferred to the town. Current population is estimated to be 4,000-4,500.

The majority of employment in the Page area is in three general areas: employment at the Navajo generating station (transportation communication and utilities sector); Federal government employment; and tourism-related employment (trade and services sectors).

During the rapid growth period and for several years after, municipal facilities and community services were hard pressed to accomodate the population. According to Page city officials, the community could handle a population of about 10,000 without substantial strain on community and municipal services. Improved building lots are available as are about 600 vacant trailer spaces. Some moderate and low income apartments and duplexes are also available.

Water supply and facilities are abundant for the present population. Page is allocated a water supply from Lake Powell sufficient for a population of 15,000, and present facilities are sufficient to store and distribute water for a population of 10,000. Sewage-treatment facilities were designed for a population of 10,000, with additional settling ponds becoming necessary as population approaches this level. Hydro-electric power is supplied by the Bureau of Reclamation from water released from Lake Powell. Page receives a large enough allocation of power that they sell some of it.

Medical facilities and personnel are adequate. The town has a 25-bed hospital, four doctors, two dentists, and a University of Utah clinic staffed with nurse practitioners. The hospital has a low occupancy rate, 31-32 percent. The physician population ratio is 0.95 per 1,000, somewhat lower than the 1.53 national average, but satisfactory for a nonurban area. The dentist population ratio (0.48 per 1,000) is the same as the national average.

Law enforcement is more than adequate, about two law enforcers per thousand inhabitants. Page has two full-time firemen; the rest of the fire department are volunteers. Ambulance service is also available.

City finances have no problem areas according to city officials, particularly as virtually all vacant land is owned by the city, and thus provides revenue to the city as land is sold. Page has no debts and no locally-levied property taxes.

School facilities in Page are excellent. Kindergarten through twelfth grade is housed (newly constructed) on the same campus. Present enrollment is about 1,800, with a low student-teacher ratio of 17:1. The physical facilities have a capacity to accomodate substantial increases in students.

Page's population is expected to be between 5,500 and 6,000 in 1985 and between 6,000 and 7,000 in 1990, according to the Page Comprehensive Plan. Little would need to be done to accomodate this growth.

f. Social Change

Lasting social and cultural change can be expected for some communities in Kane and Garfield Counties at the projected and higher levels of coal production. As workers and their families move into these counties from outside the region and State, the communities will reflect less the present rural, Mormon character. A new urban orientation will develop that is consistent with the cultural experiences of the migrants. Current ways of living will change and, as mentioned in chapter V, may cease altogether. The probable impacted communities are tiny (7 of 12 have a current population of less than 200) and easily will be overwhelmed by even relatively small numbers of migrants anticipated under the projected level of coal mining and other developments.

4. TRANSPORTATION AND UTILITIES

The activity involved in production at the projected level of coal development, 12 mty, would place substantially greater demands on the highway system in southern Utah than existed in 1975. These projections of average daily traffic (ADT) on selected highway segments (table IV-20, fig. IV-4) are based on projections of production and population increases. The transportation analysis assumed that the increased population (See Socioeconomic Section) would locate in existing communities. The analysis also assumes that projected traffic would be accommodated by some modifications to the present highway network and by adding some new roads to mine sites.

Segments of US-89 between Kanab and Glendale and between Glen Canyon City and the Arizona border would require additional capacity, which could be provided by adding passing lanes. In addition, turning lanes would have to be added at the intersection of US-89 and U-277 at Glen Canyon City. The Utah Department of Transportation has no plans for these improvements at this time, therefore the costs involved are unknown. If implemented, the improvements would be financed by a combination of Federal and State funds based on a formula for "matching funds" set for each class of Federal aid highway by the Federal Aid Highway Act. A potential bar to implementation would be the lack of State funds.

No major improvements are planned at this time to provide access to the Warner Valley Powerplant site. Construction workers and materials for this plant will peak traffic. The relative short duration of these peaks probably would not, however, justify major highway improvements. After the plant is in operation, it would generate comparatively little traffic. Most construction and plant workers probably would live in the vicinity of St. George and Hurricane. Traffic increases, therefore, would be greatest south of these towns. More frequent maintenance and localized road, improvements would most likely be required. In general, the same is true of roads to the Alton mine. The prolonged duration of traffic peaks, however, would most likely require paving the access roads from Alton (north of minesite) and Glendale (fig. IV-4).

Coal mined in the Kaiparowits Plateau area would be hauled by truck. This truck traffic will probably reach US-89 from 277 at Glen Canyon City and from that point proceed to destinations in Arizona or elsewhere by way of US-89. Once in Arizona, this traffic would cross

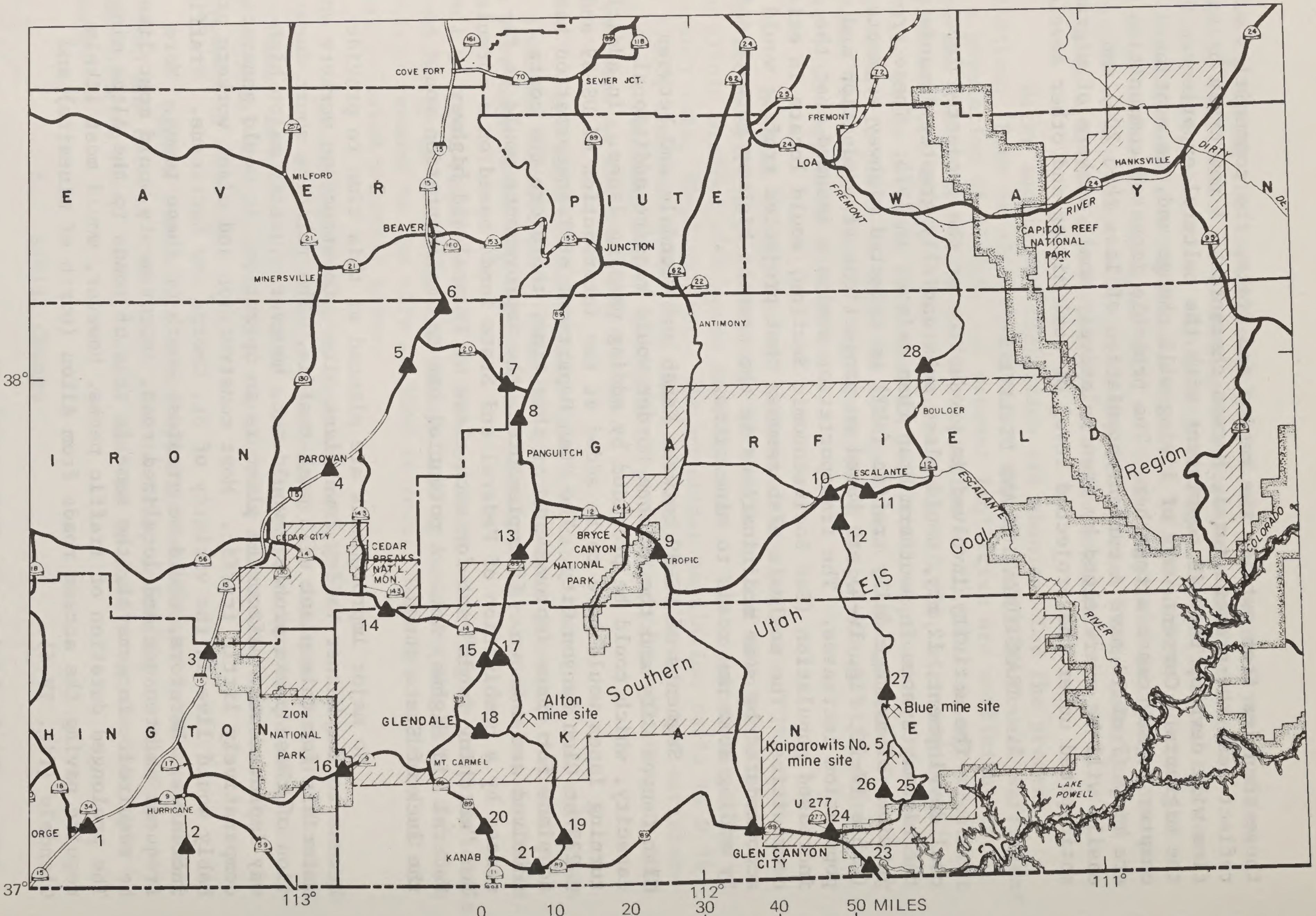


Figure IV-4.--Highway traffic count locations in southern Utah.

Table IV-20. Projected average daily traffic on selected segments of Utah highways

Segment[1]	1975 ADT	1980 ADT	1985 ADT	1990 ADT	1990 Trucks
1------	5,580	7,148	7,462	7,828	1,340
2------	0	-	-	100	0
3------	4,660	5,970	6,232	6,538	1,101
4------	4,940	5,726	6,378	6,757	1,067
5------	4,000	4,636	5,164	5,471	1,018
6------	4,275	4,954	5,518	5,846	1,097
7------	300	325	392	436	51
8------	1,390	1,505	1,816	2,018	348
9------	415	474	591	674	97
10------	290	331	485	561	77
11------	125	143	207	239	29
12------	0	0	0	0	0
13------	1,475	1,719	2,801	3,404	438
14------	355	415	487	529	52
15------	1,650	1,924	3,134	3,809	496
16------	810	1,090	1,135	1,207	75
17------	135	121	468	643	30
18------	20	18	582	608	0
19------	30	38	112	123	4
20------	1,590	2,002	2,848	3,444	412
21------	1,020	1,230	1,633	2,080	296
22------	890	1,073	1,425	1,814	255
23------	890	-	-	2,336	777
24------	55	-	-	2,988	612
25A-----	0	-	-	1,188	522
26------	0	0	0	0	0
27------	20	25	30	40	0

[1]Segments shown on figure IV-4.

the Navajo Bridge across Glen Canyon (fig. I-2). The bridge could accommodate the traffic, as long as legal load limits are not exceeded. Depending on ultimate destination segments of highways in Arizona may need to be modified. The transportation analysis assumes only minor reconstruction of the road northward from the Blue and Kaiparowits No. 5 mines to Escalante.

Mining plans and subsequent revisions for the Blue and Kaiparowits No. 5 mines have indicated that an existing county road from the mines to State route U-277 and Glen Canyon City would be used for truck haul. This route would also carry all the commuters to the mines, as well as service-truck traffic.

Projected traffic from the Blue and Kaiparowtis No. 5 mines to Glen Canyon City would most likely require a paved asphalt highway designed to accommodate legal State loads and consisting of two 12-foot-wide travel lanes, with 6-foot shoulders. At a minimum, a 100-foot-wide right-of-way would be desirable, with additional widths needed to maintain cuts and fills. The potential for growth in coal production beyond the probable level, with a resulting growth in traffic, may influence the county to acquire an even wider right-of-way.

Road upgrading would require an unknown amount of cuts and fills. The road would be on the Tropic Shale and clay soils. When wet, this material becomes unstable; therefore, it is unsuitable for a roadbed. The proposed road must either be routed around unstable roadbed or the road foundation must be prepared accordingly.

This segment of road was included in route studies connecting Glen Canyon City to the State road system on the opposite side of the Kaiparowits Plateau (chapter II). The studies, however, envisioned coal development many times greater than the projected level considered in this analysis.

Necessary improvements to the road in the NRA are in dispute. The county has authority only to maintain this part of the road in its present configuration; it cannot be improved without National Park Service approval. The Glen Canyon NRA enabling legislation specified that the road between Glen Canyon City and the Bullfrog Basin in the NRA be a scenic, low speed road. The NPS interprets this to mean a parkway type road, not necessarily built to present standards, which would be closed to commercial traffic, including coal trucks. Consequently, NPS will not permit improvement of the present road to accommodate coal traffic. The NPS does not exercise control over traffic on the present road; therefore, coal trucks are free to use it. In its present configuration, however, the road cannot accommodate projected coal traffic. Its inadequate width for passing, its lack of pavement with resulting dust problems, and its general impassability in wet weather severely limit traffic capacity. Although not precisely quantifiable, the capacity, is significantly below projected traffic. A change in the NPS restrictions would be required before the road could accommodate the projected traffic.

An alternative route is available that would not cross the NRA. This alinement traverses northward from Glen Canyon City climbing the west side of Nipple Bench (fig. IV-5). The road would then turn eastward to the Smoky Mountain County Road that passes both the Kaiparowits and Blue mine properties. Segments to the mines would then be improved north and south. Such a highway, if improved, could handle the projected traffic. This possibility is described in more detail in part II.

Overall increased highway use in the region would result in several adverse impacts. The most visible would be increased traffic. Based on calculations averaged for all selected points, traffic in the region would be 1.75 times greater than in 1975. Traffic is well below highway capacity. Although the present highway system can accommodate the projected traffic, increased traffic would decrease the present level of efficiency. More vehicles on the same roads would result in longer travel times and intersections in the more developed areas will be more congested. The incidence of accidents would increase at a rate commensurate with the rate of traffic growth.

Increased traffic, in particular increased numbers of trucks, would accelerate deterioration of highways. This would require that normal maintenance schedules be accelerated. To some degree, increased cost of maintenance would be offset by increased revenues generated by taxes on fuel, although improved fuel efficiencies would reduce these revenues. With respect to highway maintenance, the Utah DOT feels that present funding formulas would be inadequate to meet anticipated demands that would result from coal development.

Increased highway use would result in increased consumption of gasoline and diesel fuel. Based on per capita consumption rates for these fuels in Utah in 1975, highway consumption of fuel in the four southwestern counties of Utah in 1990 would amount to 39,846,000 gallons, approximately 17 million gallons more than in 1975. If the percentage of trucks (relative to lighter and smaller vehicles) increases in 1990 over that in 1975, fuel consumption would be increased accordingly. Fuel efficiency of automobiles and trucks has, and will continue to, increase after 1975. The increase, therefore, is somewhat overstated, although the degree of overstatement is unknown. If average motor vehicular fuel efficiency increases 75 percent between 1975 and 1990, the fuel consumed by motor vehicles in 1990 would be approximately the same as consumed in 1975.

More traffic would increase highway-related wastes, such as fuels, motor oils and related fluids, plastics, rubber, and various metals. Although most of these wastes are initially deposited on or adjacent to highways, storm runoff may wash them into the aquatic environment.

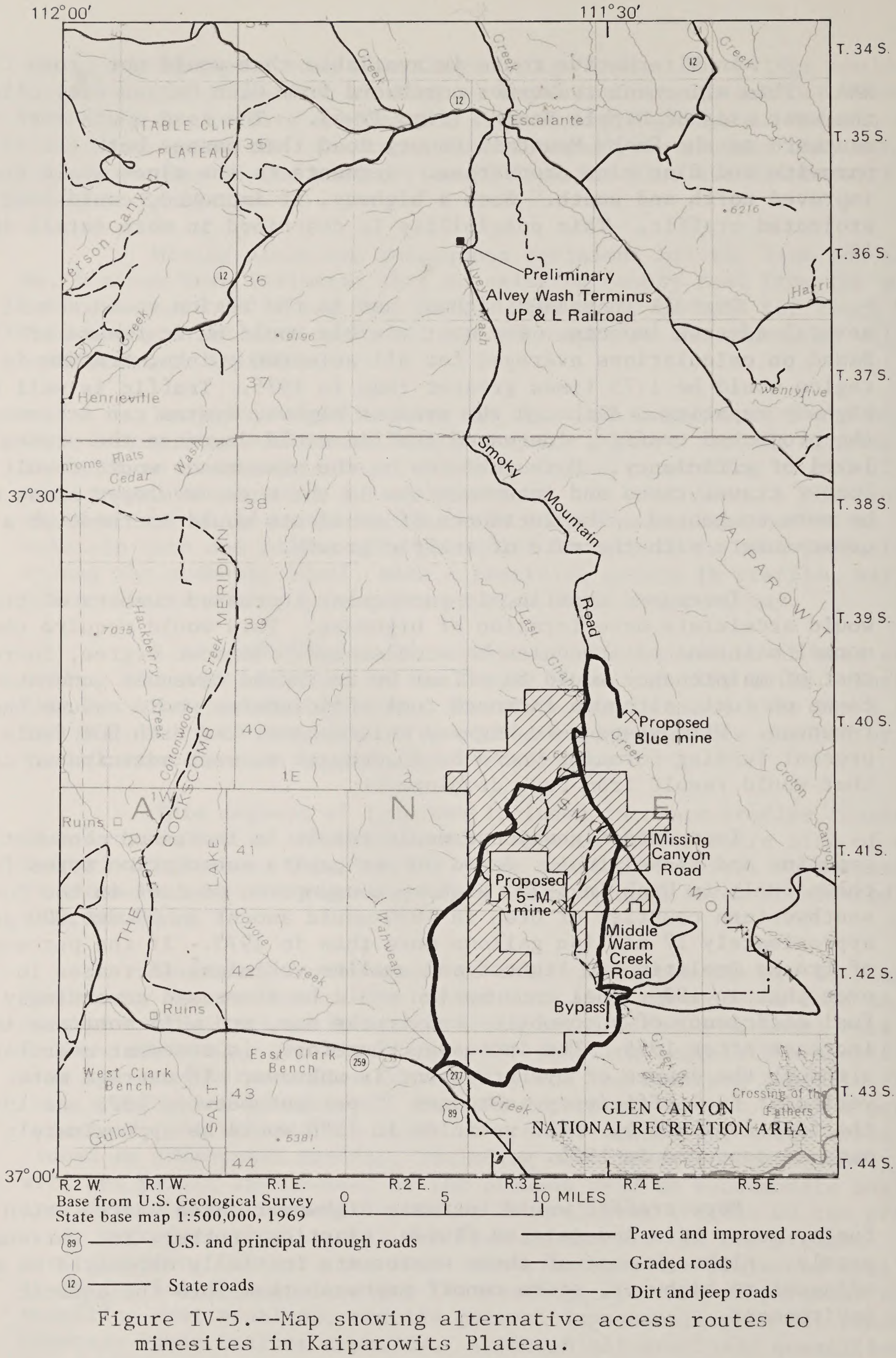


Figure IV-5.--Map showing alternative access routes to minesites in Kaiparowits Plateau.

A powerline is only preliminarily proposed by the proponent of the Blue mine (See site-specific analysis in part II). The Kaiparowits No. 5 mine would operate on portable power generated at the site. A powerline from existing transmission lines southwest of Glen Canyon City northward to the Blue mine would be about 25 miles long (fig. IV-5). Based on a 60-foot right-of-way, about 182 acres would be needed. Surface disturbance, using minimum clearance procedures, would total about 44 acres, including an access road, but would be only about 90 acres if the powerline were to follow an existing road. The latter route would present an illegal shooting hazard to raptors, however. In addition, vegetation over 8 feet tall would have to be topped or removed at midspan, but anything under 40 feet tall at the edge of the right-of-way could be left undisturbed. Other than land disturbance, there may be esthetic intrusion; if the line is built along the access road, however, travelers would view the landscape under the lines. Once built, the powerline might serve also the proposed Kaiparowits and Red mines.

Telephone service would be needed to the same mines. If the modern tendency of burying cable within the highway right-of-way is followed by the telephone company, no additional right-of-way would be needed, and there would be no material environmental impact. Microwave service would require clearing of sites (1 to 2 acres per site), construction of access roads to sites, and the visual intrusion of microwave towers. Overhead telephone lines probably would follow the highways; an additional 10-foot right-of-way would amount to 1.2 acres per mile and surface disturbance would be small. Poles are likely to be more numerous and wires hung lower than for a powerline, so that visual intrusion could be obtrusive.

Transmission lines to be built in conjunction with the Allen-Warner Valley project and the Alton coal field are described in chapter I. The proposed powerline from Warner Valley to St. George would not follow major highways, although it would cross I-15, in particular. The proposed powerline from a proposed UP&L substation northwest of Panguitch to the Alton minesite would follow the Sevier Valley and U.S. 89, but it would parallel the highway on the opposite side of the valley, near the toe of the mountains, and would not be especially visible.

5. RECREATION

At the projected level, impacts would accrue from three basic sources: a) increased use of recreation facilities and use areas (tables II-32 and II-33) by new residents associated with coal mining and related activities, b) increased industrial traffic, and c) exclusion of properties occupied by mine plantsites and some ancillary facilities presently used for recreation.

Overall increases by residents in recreation use are projected (table IV-21) as are increases in visits by main purpose of trip by residents (table IV-22). Projected also are residents and non-residents visits to the three multicounty areas (table IV-23).

Table IV-21.--Recreation visits (trips) and visitor days use; by residents of the region at the projected level

	Coal production level		
	Present level	No action level (0.0 mty)	Projected level of production (12.0 mty)
Population of region to support coal production[1]			
1976	48,525	--	--
1985	--	62,810	68,681 [4](5,871)
1990	--	68,096	76,432 (8,336)
Recreation visits by residents[2]			
1976	444,000	--	--
1985	--	574,700	628,400 (53,700)
1990	--	623,100	699,400 (76,300)
Recreation visitor days by residents[3]			
1976	1,385,300	--	--
1985	--	1,793,100	1,960,600 (167,500)
1990	--	1,944,100	2,182,100 (238,800)

[1] Population figures from socioeconomics section.

[2] Average out-of-community but with region recreation trips per household for worst case analysis is 9.15 trips per year.

[3] Visitor days equals 12 hours aggragated by one or more persons. Each out-of-community but within region recreation trip in the worst case averages 3.12 visitor days (37.44 hours).

(Both [2] and [3] are from baseline information calculated from figures in Utah Resident Recreation Travel, 1974, 1975, and 1976, J. D. Hunt, W. H. Becker, M. J. Dalton and S. F. McCool of the Institute for the Study of Outdoor Recreation and Tourism, Utah State University, Logan, Utah 84322.)

[4] Population, recreation visits and recreation visitor days use above the normal increases for 1985 and 1990 as a result of increased coal production are shown in parentheses.

Table IV-22.--Out-of-community outdoor recreation trips by residents of the Southern Utah Coal Region[1] projected level

Recreation activity	1976		No action level				Projected level (12.0 mty)			
			1985		1990		1985		1990	
	Percent of total[2]	Number	Projected total	Increase	Projected total	Increase	Projected total	Increase	Projected total	Increase
Driving for pleasure and sightseeing------	21.7	95,500	124,700	29,200	135,200	39,700	136,400	11,700	151,800	16,600
Fishing----------------------------------	15.0	65,800	86,200	20,400	93,500	27,700	94,300	8,100	104,900	11,400
Hiking and back packing-------------------	10.6	46,600	60,900	14,300	66,000	19,400	66,600	5,700	74,100	8,100
Water sports (boating, swim, waterskiing etc.)----------------------------------	9.4	41,500	54,000	12,500	58,600	17,100	59,100	5,100	65,700	7,100
Picnicking--------------------------------	6.9	30,400	39,700	9,300	43,000	12,600	43,400	3,700	48,300	5,300
Skiing------------------------------------	5.7	25,100	32,800	7,700	35,500	10,400	35,800	3,000	39,900	4,400
Spectator sports (watching sporting events, etc.)----------------------------	4.4	19,300	25,300	6,000	27,400	8,100	27,600	2,300	30,800	3,400
Camping-----------------------------------	4.0	17,700	23,000	5,300	24,900	7,200	25,100	2,100	28,000	3,100
4-wheel, motorcycling, ORV use------------	3.7	16,400	21,300	4,900	23,100	6,700	23,300	2,000	25,900	2,800
Hunting big game--------------------------	3.2	14,200	18,400	4,200	19,900	5,700	20,100	1,700	22,400	2,500
Golf--------------------------------------	3.0	13,000	17,200	4,200	18,700	5,700	18,900	1,700	21,000	2,300
Hunting small game and target shooting----	2.1	9,400	12,100	2,700	13,100	3,700	13,100	1,000	14,700	1,600
Winter sports (snowmobiling, ice skating, tubing, etc.)---------------------------	2.1	9,500	12,100	2,600	13,100	3,600	13,200	1,100	14,600	1,500
Other (rockhounding, gathering resource products, nature study, etc.)[1]----------	8.2	35,600	47,000	11,400	51,100	15,500	51,500	4,500	57,300	6,200
Totals---------------------------------	100.0	440,000	574,700	134,700	623,100	183,100	628,400	53,700	699,400	76,300

[1]Participation by present population during sample period was less than one-half of one percent in any one activity.

[2]Individuals may or may not have participated in more than one activity, as listed, during each trip. Figures shown are for major purpose of trip and total 100 percent; as an example, trip may have primarily been for fishing and recorded as such; however, several other activities may have occurred on the same trip. No time element is involved in this summary sheet.

Based on information from Utah Resident Recreation Travel, 1974, 1975, 1976, Institute for the Study of Outdoor Recreation and Tourism, USU, Logan, Utah, by J. D. Hunt, W. H. Becker, M. J. Dalton and S. F. McCool.

Present levels (1976) of recreation use at most developed sites and of recreation use areas and attractions are above or near carrying capacities.

Coal production at the rate of 12 mty would result in an increase of 53,700 recreation visits and 167,500 recreation visitor days use by 1985. By 1990, visits would increase to 76,300 and visitor days use to 238,000. The increased use would further compound impacts described in chapter II. In addition, increased industrial traffic would create the probability of more accidents, impeding normal flows of recreation traffic (driving for pleasure and sightseeing), and increased levels of dust, other air pollutants and noise nuisances along and adjacent to travel routes (see air quality, chapter IV).

Sites occupied by mine plants would be removed from recreation use during the life of the mines. Stripping areas at Alton mine would be removed from use when mining was in progress. Recreation use on adjacent land areas would be altered by introducing more people, thus reducing the opportunity for hunting, fishing, backpacking, solitude, and unconfined back-country recreation uses. This type of use is presently limited and is mainly in areas with special features or significant user attractions.

6. ARCHEOLOGY AND HISTORY

It is not possible to accurately quantify the number of archeological and historic sites that would be directly or indirectly impacted in the Southern Utah coal region. A rough estimate can be made by extrapolating the AERC class II inventory data. Eleven archeological sites could be directly impacted for each section of ground disturbed on Federal land. This estimate ranges from less than 1 per section to 32 per section. A site density map (fig. II-27) prepared by AERC shows the areas in the region that have the greatest and least potential for impacts to cultural resources.

Impacts on sites directly associated with coal mining and related activities would be mainly the result of disturbance by earth moving equipment of previously unidentified (usually buried) sites.

Increased area population, as a result of coal development, coupled with the opening of previously inaccessible areas, would result in increased vandalism, primarily to off-project sites. Some impacts would occur simply through greatly increased area use, even without malicious intent.

Loss of sites through necessary salvage constitutes an adverse impact on research potential, although data extracted from them would be preserved.

Table IV-23. Recreation visits to multi-county sub-regions.

Multi-county Sub-regions -1-	1976 Resident and non-resident visits to each sub-region -2-	1985 Recreation Visits to multi-county regions at 0.0 mty coal production level[1] -3-	1985 Recreation Visits to multi-county regions at 12.0 mty production level[2] -4-	1990 Recreation Visits to multi-county regions at 0.0 mty coal production level [1] -5-	1990 Recreation Visits to multi-county regions at 12.0 mty coal production level[2] -6-
Color Country	3,791,350	7,088,450	7,142,200	10,035,200	10,111,500
Canyonlands	2,051,300	3,848,200	3,901,900	5,447,900	5,524,200
Northern Arizona	2,550,000	4,767,600	4,821,300	6,749,600	6,825,900

[1]Resident and non-resident visits based on a 7.2% increase in recreation visits per year (7.2% is average annual increase in recreation visits for National Parks, National recreation areas and other major recreation use areas in Southern Utah for 1966 through 1976, source: National Park Service records 1966 through 1976. Visitor day use of National Forest lands increased at the rate of 6.5% per annum for the period of 1969 through 1976.

[2]7.2% increase per year at 0.0 mty production plus increase in recreation use by new residents to produce 12 mty of coal. The total increase (53,700 visits for 1985 and 76,300 visits for 1990) in recreation visits from new coal production (12 mty) population element was added to each multi-county sub-region to present a "worst case analysis".

With some projects, there would be substantial changes in the setting or context integrity of sites, particularly historic sites. Stabilization, restoration or moving of buildings or artifacts to other locations is also an adverse impact to context and in situ value and integrity.

Positive impacts will also result from coal development. Valuable information has already been generated by the AERC surveys. Other surveys will be necessary prior to any disturbance and will result in the accumulation of data that would otherwise not have been available until sometime in the future, or that may have been lost in the interim. Any salvage excavation that is required will result in the preservation of data and material (including some that might otherwise be lost to vandalism in the long run), although in situ value is lost.

7. ESTHETICS

Impacts to the visual resource within and adjacent to the lease areas, as well as seen from offsite (i.e., Alton strip mining as seen from the south rim of the Paunsaugunt Plateau and particularly from Bryce Canyon National Park) are described in the individual site specific analyses in part II.

Communities listed in chapter II would increase in size, as indicated in the socioeconomic section, resulting in changes from small or rural-ranching community character to one of more urbanization. Some older structures within all five communities could be razed.

Ancillary facilities, such as powerlines, water and telephone lines, and improvement and extension of transportation systems, would be necessary. These would increase man-made intrusions (modifications) of the natural landscape character.

Secondary impacts would accrue to the visual resource in the region by increased off-road vehicle use, littering, and vandalism.

CHAPTER V: UNAVOIDABLE ADVERSE IMPACTS

At the present level of technology, about 65 million tons, or 21 percent of estimated inplace coal might be lost. Of this total, about 45 million tons of coal would be unrecoverable at the proposed Kaiparowits No. 5 mine (reference chapter IV land). Subsidence over the proposed Blue and Kaiparowits No. 5 mines would be unavoidable and might affect as much as 3,000 acres. Locally, fractures, depressions, and surface buckling might accompany the subsidence. Mine fires from spontaneous combustion in abandoned and sealed mines are a remote possibility should air enter through subsidence cracks. In areas of strip mining and mine-portal structures, minor changes in topography and drainage patterns would be unavoidable, as would be increased erosion on disturbed land.

Unavoidable destruction, disturbance, and removal of paleontological resources, both exposed and unexposed, would occur. The significance of this impact cannot be presently meaningfully assessed owing to the lack of data and evaluatory criteria.

Soils on 19,500 acres would be disturbed for mining, mine facilities, transportation systems, powerlines, slurrylines, water projects, community development, and powerplants. About half of this area would be affected by coal mining and half by the Allen-Warner Valley Energy System. Onsite erosion of disturbed areas by wind and water could increase by an average of ten cubic yards per acre per year (reference chapter IV land). The total disturbed area is 19,500 acres. Over 30 years the average annual soil movement could be 6,000 cubic yards. With mitigation, erosion would decrease over time until the area is reclaimed (estimated within 5 years). Soil movement by water erosion would be limited essentially to onsite impacts; however, soil would be moved locally as well as outside the region. Soil productivity would not be reduced below 90 percent of its original productivity on reclaimed sites. Increased vegetative production could be expected shortly after reclamation on much of the disturbed land due to fertilization, but productivity would level off over five to ten years to near what it was before disturbance.

The projected increase in population would result in increased impacts to soils at developed recreation sites and areas where ORV's are used. ORV's would reduce vegetative cover, loosen, compact, and rut soil, which would result in erosion and movement of soil. Loosening the soil by ORV's would result in severe wind erosion on many of the arid sites in the impact area, possibly adding to the average 6,000 cubic yards per year resulting from soil disturbance associated with the proposed mines and AWV power project. The amount and location of additional ORV use cannot be quantified.

Mining, that drains water from saturated sandstone, will cause local water-level declines and change local flow patterns. The amount of ground water and sandstone affected, however, would be small--less than one tenth of one percent of that in the region.

Ground-water use near Alton for mining and for the Allen-Warner Valley Energy System could decrease the yield of springs and wells that tap the Navajo Sandstone.

Ground-water use in Warner Valley could decrease the yield of springs and wells that tap the Navajo Sandstone or decrease the yield of irrigation wells that tap the alluvium, depending upon which aquifer is used.

The greatest impact areas on air quality are associated with the mines and associated unpaved roads south of Escalante and around the Alton, Blue, and Kaiparowits No. 5 mines. The impact is greater than the Class II 24-hour increment around the Alton strip mine. The annual average TSP impact also exceeds the Class II increment. The Class I areas are impacted less than the Class I standards for both short-term and annual averages. The eastern portion of the Alton lease area, which was not analyzed, would possibly cause Class I PSD particulate standards to be violated at Bryce Canyon National Park.

Background visual range based on the annual average TSP concentration is estimated to be 35 miles. The visual range in most of the southern region is greater than 25 miles, as the incremental TSP impact is less than 10 ug/m^3 over most of the area. Around the impacted areas, the visual range will be reduced to a worst-case value of 17 miles near the Alton strip mine, and the visual range will be impacted significantly around the Blue and Kaiparowits No. 5 mines, with the visual range reduced to less than 3 miles. No general regional brown discoloration will result from NO_2 emissions.

Vegetation on 9,400 acres would be destroyed by mining and construction of ancillary facilities and urban development. This lost vegetation would have provided 64 AUM's per year of grazing for domestic livestock over an average of a 30-year mine life, for a total of 4,920 AUM's. Moderate volumes of fenceposts, firewood, pinyon nuts and Pinyon Christmas trees would also be destroyed. A few threatened and endangered plants may be lost along with an unquantifiable amount of vegetation in general to the unplanned actions of construction activities and the activities of the generally increased population.

Loss of habitat for a variety of wildlife species, and a subsequent reduction in numbers would be unavoidable. Unavoidable losses of habitat for individual species would include: 723 acres of deer winter range; 9,457 acres of cottontail range, up to 450 acres of pheasant habitat; 2,000 acres of sage grouse habitat; and 350 acres of summer turkey range. The temporary loss of 9,095 acres of wildlife habitat occupied by project facilities could not be avoided. The permanent loss of about 2,000 acres of wildlife habitat owing to urbanization, recreational home developments, and roads would be unavoidable. Loss of wildlife due to wire strikes, vehicle strikes, and illegal shooting could not be prevented.

Construction of the Allen-Warner Valley Energy System, as proposed, would jeopardize the continued existence of the endangered woundfin. Increased water for the added population associated with the Warner Valley powerplant would reduce the habitat of the continuing proposed threatened/endangered St. George and a new unnamed snail.

If culinary water to meet increased population needs at the proposed level of action were drawn from existing agricultural water supplies, approximately 222 acres of irrigated cropland in tillage rotation would be removed from production by 1990. If community expansion took place on irrigated lands, an estimated 362 acres of agricultural land could be adversely affected at the projected level of action.

The potential actions at the projected level would increase the population of the region from 46,500 in 1977 to 66,950 by 1990. Most of this addition would be concentrated in Kane and Garfield Counties. The two counties have a combined 1977 population of 7,400; it would reach 18,200 by 1990.

Immigration of workers and their families would occur in numbers sufficient to quickly outnumber the existing labor force in Kane County because the area labor force is small and offers little capacity to supply requirements should coal mining expand rapidly. The diversity of backgrounds of the migrants probably would contrast sharply with social or cultural characteristics of the area's current residents and might lead to social conflicts.

Competition for labor will adversely affect existing area businesses because coal mining and construction employees will be paid higher wages than are typical of the area, where few high-paying jobs are to be found at present. Moreover, rising total and average incomes will spur competition for goods, services, and housing, as limitations to a rapid augmentation of supply exist, aggravating the problems of those receiving low or fixed incomes, particularly the elderly.

Demand for housing will expand rapidly. Kane County alone will require over 1,900 more dwelling units than would be the case in the absence of coal mining (an amount greater than its 1970 stock of existing housing). Housing quality will decrease temporarily, and much of the incoming population will live in mobile homes.

Temporary unavoidable financial pressure on local government will result from rapid growth. Both the quality and the quantity of some municipal services may decline. This will be truer of communities, in which the growing population will reside, than of counties, where tax revenues will rise due to location there of coal mining activities. Of note in this regard are the effects of rapid growth on water supply, sewage and solid waste disposal, health care and hospitals, social services for personal and family problems, police and fire protection, and education.

Social and cultural problems engendered by rapid growth due to coal mining will not only be bigger than those some communities may have experienced before, but will be different and may threaten the fabric of community life. Residents anticipate greater amounts of crime, deliquency, drug and alcohol abuse, and the like; in other words, rapid growth is thought likely to produce more of the same kinds of problems already present or known about. It is not widely accepted that effects on basic community institutions, values, and ways of life will result. Evidence suggests these effects will occur. Moreover, a difference between what is expected and what actually may occur will add to social problems in ways difficult to anticipate.

Because the community, as a social entity, is a source of personal identity, kinship, and a sense of belonging for its residents, existing relationships, and the complex assumptions, values, and perspectives on which they are based, are simply taken for granted. Practically speaking, they are subconscious. Though supports for community life, people often become aware of them only after everyday activities have been disrupted. Rapid growth due to coal mining will profoundly alter such relationships. Drastic and rapid alteration of the local economy will yield difficult changes in other areas of life--in family, religions, and political patterns, for example. Kane and Garfield County communities, which would experience the most immediate effects of expanding coal mining, must be prepared not only for economic changes and problems in providing municipal services, but for other kinds of lasting social and cultural changes as well.

The more intensive use of transportation facilities is a necessary and unavoidable part of resource development. Taking into consideration the historical trends in western coal development, the addition of significant volumes of highway traffic is unavoidable and would result in accelerated deterioration of the regional highway system and increased levels of accidents, fuel consumption, air pollution, noise, and congestion.

The construction or reconstruction of 115 miles of roads to provide direct mine access would require the removal of 530 acres from other use. Upgrading of the highway system to meet the increased traffic levels, in particular, expansion of portions of U.S. Highway 89, may require additional rights-of-way.

Unavoidable adverse impacts would result from construction of an unquantified mileage of power distribution lines, plus 70 miles of service lines to the various mines. Where additional rights-of-ways would be needed, the amount of land required would be approximately 6 acres per mile of line for a 50-foot right-of-way. In some places, it is anticipated that existing lines would be upgraded with little additional environmental impact.

Unavoidable adverse impacts would result from consumptive recreation pursuits such as: a) hunting big and small game and fishing, because of the finite resource involved. More pressures in hunting and fishing would result in a lowering of animal and fish populations and thus hunter and fisher-man success, or a decrease in bag limits, seasons, or licensed sportsmen afield; b) destruction or deterioration of resources such as soils, vegetation, wildlife habitat, archeological sites, and new or additional back-country encroachment by ORV's ; c) picnicking and camping in both developed and dispersed areas where deterioration or destruction of natural and cultural resources takes place as a result of overuse or use above carrying capacity of the facilities and land.

Other significant unavoidable adverse impacts would result from overcrowding. In general, this would result in an overall lowering of desired recreation user experience a) on travel routes used for pleasure driving and sightseeing, where additional encounters with other vehicles would decrease enjoyment and generate safety hazards; b) in back-country areas used for hiking and backpacking, where solitude and uncrowded, unconfined recreation is sought; c) in developed recreation sites and dispersed areas used for camping and picnicking, where privacy will be reduced; and d) at spectator sporting events and in outdoor recreation activities, such as skiing, boating, and golf, where capacities are restricted (i.e., standing in lines, waiting turns, or unavailability because of capacity limitations).

Impacts would result from occupancy and use of the minesites and adjacent areas. This would exclude onsite recreation during the life of the mines.

Improved access resulting from the proposed action would be considered by some people as favorable and by others as unfavorable. This would depend on whether they were seeking more access and developments, or were seeking back-country recreation in areas presently inaccessible to the general traveling public.

Salvage excavations of threatened archeological or historic sites is an unavoidable adverse impact. Data are preserved, but sites or parts of sites are lost from the rapidly diminishing reservoir available for future research. Some degree of unavoidable impact would occur for buried archeologic or historic sites encountered during dirt-moving operations. Some part of the site would be lost even if it were recognized rapidly. Changes in settings of sites, either by the introduction of project activities and facilities or by moving certain things to avoid impacts, are unavoidable. Impacts in heavy use areas on archeologic or historic sites are unavoidable. Vandalism impacts are mainly unavoidable. It is extremely difficult to police vandalism.

Unavoidable adverse impacts to esthetic values include a) the strip-mining operation within the Alton coal field, as viewed from Yovimpa Point in Bryce Canyon National Park during the latter stages of the project; b) the establishment of mine plantsites, ancillary facilities, and mining activities where few man-made intrusions now exist (Kaiparowits Plateau) and where new ancillary facilities cross or parallel main travel routes and viewing the natural landscape is of primary concern to viewers; and c) deterioration or destruction of unique scenic features, soils, vegetation, archeological or historical sites, and developed facilities by vandalism, littering, ORV use and overcrowding of the regional recreation resource by the increased population.

The esthetic impacts, as described in chapter IV for communities, will be viewed by some as adverse; others would view changes and growth as beneficial. Strict zoning regulations on location, building types, size and heights or structures, and size of building lots would be needed to ensure against haphazard or out-of-place developments in present or new communities.

In terms of adverse impacts on a regional basis, visual resource impacts would be minor, primarily because of the location of the proposals, the low number of onsite visitors, and the visual quality rating and sensitivity levels designated for the areas (Roy Mann Associates, 1977).

CHAPTER VI: SHORT-TERM USE VERSUS LONG-TERM EFFECTS

The short-term is that period of time that includes the productive life of the proposed action plus a few additional years required for reclamation of the sites and other mitigating actions. The long-term is that period of time beyond the short-term in which subsequent impacts, both adverse and beneficial, would continue to affect the environment.

At the probable level of production, 248 million tons of coal would be removed by mining. Topography on 8,300 acres would be modified by strip mining over the long term. Subsidence above underground mines (about 3,000 acres) would continue through the life of the mines and at a reduced rate, for a short time thereafter; resultant alteration of the land surface would be minor, but permanent. Coal bed fires are possible, but probably minor, long-term adverse effects.

Activities related to mining would result in impacts to an unknown number of exposed and unexposed fossil localities. These activities would also result in a gain in knowledge of paleontological resources because of surveys and exposure of resources which might never have been found without excavation.

Soil production would be lost for the long term on 2,000 acres of land from construction of permanent facilities for mining, and transportation systems, power generation, and community development.

After disturbed areas are reclaimed, the projected long-term impacts on soil productivity would be minimal, as the disturbed sites would be returned to a pre-mining condition. Undoubtedly the productivity of some soil would be reduced below its initial capability, but the productivity of other soil would be increased above its initial capability.

The short-term and long-term regional air-quality impacts are small except for the TSP impacts from unpaved roads. Paving of these roads would make all regional TSP impacts small.

In the short term, vegetation, including associated range forage and forest/woodland products, would be destroyed by the various mines, mine facilities, and urban growth. In the long term, after successful reclamation, the vegetative productivity and range forage could be increased by about 75 percent overall. Normal watering and grazing patterns for domestic livestock would be disrupted over both the short and long term. Areas committed to facilities such as roads, railroads, and urban development would be lost from vegetative productivity in the long term. Native plant succession would be retarded by the projects. Many years (20 to 60) would be required to re-establish the same plant communities on a given site (especially the Pinyon-Juniper Woodland type). However, overall vegetative cover and productivity would be quickly restored through proper reclamation. Some threatened and endangered plants (chapter II) may be inadvertently lost but this loss cannot be quantified.

The short-term use of 9,457 acres of wildlife habitat for coal development would alter present ecosystems and result in long-term impacts on some wildlife species. These long-term impacts would be of local significance only. Deer, cottontail, pheasant, sage grouse, and turkey would suffer reduced habitat, and long-term productivity would be reduced.

In addition to losses of habitat, the increased human population would cause a long-term change in habitat-use patterns. Species such as elk, bobcat, mountain lion, bear, bighorn sheep, turkey, and raptors would avoid areas of extensive human use. The result would be an effective reduction of habitat, even in the absence of no physical destruction. The effect would be a long-term reduction in productivity.

The long-term productivity of some species would be enhanced because of changes in vegetative types, topography, and ecosystems. Examples would be: sparrows, starlings, robins, and domestic mice and rats in response to urbanization; small mammals attracted to roadways and reclaimed areas; and raptors and carnivores benefitting from increased prey and more favorable hunting conditions in disturbed or reclaimed areas.

Extirpation of local populations of species present in small numbers, such as the spotted bat, spotted owl, peregrine falcon, Gila monster, and desert tortoise, would eliminate long-term productivity of those species unless reoccupation occurs.

Overfishing the small trout streams would continue beyond the life of the projects.

Coal production at the projected level would generally result in more intensive use of the existing transportation system which would be upgraded as necessary. After the cessation of coal development, coal related transportation movements would terminate. Decline of transportation movement would then be dependent on the residual population and remaining economic activities and cannot be predicted at this time.

Mine access roads may be removed and the right-of-way reclaimed at the request of the land management agency. However, the major road probably would not be removed because of the present lack of transportation in the region.

Utility lines to the individual mines are likely to be salvaged at the cessation of mining, hence are a short-term effect. However, the major distribution lines, transmission lines and other facilities are likely to remain as semi-permanent features, being used to support other mines opening in the same areas.

Short-term coal production, along with the projected increase in recreation use by 1985 and 1990, would have long-term impacts on recreation in the region. Impacts would be expected to continue and increase on a long-term basis. More overcrowding would be expected in major recreation-use areas and at developed sites and facilities. Compromises in use and recreation-experience will be the long-term result. The compromises will include additional or new restrictions and regulations on recreation use and activities, restricted length of stays, ORV restrictions, designated area camping only, lowering of bag or creel limits, and so forth. This situation would result by 1985 and 1990 without coal production. Coal production would, however, add to the long-term effects and impacts by the numbers of visitor and visitor days indicated in chapter IV.

Any active alteration (salvage, context changes, loss of buried/undiscovered sites) of archeologic or historic sites owing directly or indirectly to coal mining would negate or seriously impair their value, particularly to science, over the long term. Vandalism would increase as a result of increased population, population concentrations, and improved access. The cultural resource would eventually be used up, and long-term scientific value would be impaired. Non-malicious abuse of the resource, owing to population and area-use, would have the same eventual effect.

Short-term mining would have long-term effects on the visual resource of the region as well as on the lease areas. Ancillary facilities would most likely remain as intrusions or modifications of the natural landscape over the long term. Mining residues and remnants would lower the visual quality onsite.

Stripping of vegetation and changes in vegetation and landform patterns within the Alton minesite (Alton site specific, part II, figs. 11, 12) would appear as extension of previously modified adjacent areas to support local ranching. After vegetation is reestablished by rehabilitation, it would not appear as a long-term adverse impact, either onsite or from Yovimpa Point in Bryce Canyon National Park.

Adverse impacts from stripping operations at Alton would be short term and would involve only those panels in 5 east (Alton site specific, part II, fig. 5) during the latter part of the proposed project. After reclamation, strip-mined areas would add some line, form, and texture to the panoramic scene from Yovimpa Point.

Changes in community size and architecture would also be long-term.

CHAPTER VII: IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS

The total commitment of coal would be 313 million tons; 248 million tons would be mined, and the remainder would be left in the ground and would not be recoverable by current methods. This total commitment represents 33 percent of the known reserves in the Alton coal field but only 2.5 percent of the reserves in the Kaiparowits Plateau coal field.

Minor, but unquantifiable, subsidence would affect about 3,000 acres on the Kaiparowits Plateau. Surface disturbances due to strip mining would alter the topography of about 8,300 acres in the vicinity of Alton; the resultant minor, but irreversible, changes in topography would probably be beneficial (see Alton site specific analysis, part II).

Irreversible impacts would accrue to an undetermined number of uninventoried exposed and concealed fossil localities.

About 7,500 tons of limestone per year and large, but undetermined, amounts of sand, gravel, and other aggregate would be used. An unknown amount of petroleum products and construction materials (including steel and copper) would be used; some of these materials could be salvaged.

Soils disturbed by mining projects, transportation systems, and housing would be permanently altered from their natural characteristics. The productive of the soils on about 2,000 acres (chapter VI) would be lost on sites occupied by permanent structures. Some soil removed by wind and water erosion would be irretrievably lost from affected sites.

Clean air is a renewable resource. No irreversible and irretrievable commitment of air resources is involved.

Vegetative productivity would be lost from 9,457 acres for an average of 30 years. This would result in a total irretrievable loss of 1,915 AUM's of domestic livestock grazing capacity. An unquantifiable volume of forest/woodland products would also be irretrievably lost. This loss would be moderate locally but very minor Statewide. Both the range and woodland products loss would be reversible. Some threatened and endangered plants may be lost.

The permanent and irreversible loss of springs, seeps, and their associated plant communities will reduce livestock and wildlife use. Increased use of water for industrial and municipal purposes will require reallocation of agricultural and livestock water on a permanent basis. If water for the needs for the population increase were drawn from existing agricultural water sources, the use of 565 acre-feet of water and 222 acres of irrigated land would be irreversibly committed to population expansion. The total consumptive use of water would be about 47,000 acre-feet per year.

The change in land use from range/woodland to permanent facilities, such as roads, buildings, railroads, and urban development, would be both irreversible and irretrievable on about 2,000 acres.

Wildlife resources irretrievably lost would include individual animals lost through loss of habitat (chapter IV). The loss of about 2,000 acres to roads, urbanization, and recreational homes would be irreversible. Losses of wildlife would be short term and reversible if populations are not reduced to the point that their reproductive capabilities are impaired.

The proposed coal-mining and related developments would irreversibly commit the region to a more urbanized, industrialized environment not compatible with some wildlife species. The long-term (25-40 years) disturbance and occupation of wildlife habitat would irreversibly change use patterns and migration routes for several generations of wildlife.

An estimated 362 acres of land would be irreversibly and irretrievably committed to community growth at the proposed level of action.

The commitment of resources to new transportation facilities would be small, consisting primarily of new mine access roads which may be removed at the request of the land managing agency. However, within the time frame of the assessment, these commitments are irretrievable. The only irretrievable commitment would result from the possible right-of-way acquisition for the widening of U.S. Highway 89 and selected intersection improvements. Commitment of equipment and energy to transport coal would be irretrievable; in the absence of identified markets, the commitment is unquantifiable. Other related adverse impacts such as congestion, air pollution, noise, and increased safety hazards would be reversible.

Materials used in the construction of utilities would be salvaged. Land dedicated to major distribution and transmission lines would be irreversible well into the future, since the tendency of power companies is to retain any alinements they have, adding or upgrading as necessary.

Increased visits and levels of use of the regional recreation resource would be irreversible. The opportunity to participate in recreation at present experience levels (i.e. relatively unrestricted or unregulated and in some places uncrowded) would be irretrievable. In addition, vandalism, ORV use, or use above acceptable carrying capacities that results in the destruction of irreplaceable or irrepairable resources, such as archeological sites, historical sites, soils, wildlife habitat, or the esthetic resource would be irretrievable.

As archeologic and historic sites are unique, irreplaceable, and nonrenewable, any disturbance or removal from context constitutes an irreversible and irretrievable commitment of the resource.

Manmade intrusions, in the form of ancillary facilities within the natural landscape, not removed after mining ceases, would create an irreversible commitment. A totally natural landscape would be irretrievable during the life of facilities, mining remnants, and residues.

Community growth and development would also be irreversible. Any loss of scenic attractions (i.e. archeologic sites, land forms, historic sites, soils, and so forth lost as a result of vandalism, overuse, and so forth would be irretrievably lost.

As archeologic and historic sites are unique, irreplaceable, and nonrenewable, any disturbance or removal from context constitutes an irreversible and irretrievable commitment of the resource.

Manmade intrusions, in the form of facility [illegible] within the natural landscape, not removed after mine closure, would create an irreversible commitment. A totally natural landscape would be irretrievable during the life of facilities, mining, roads, and residues.

Community growth and development would also be irreversible. Any loss of scenic attractions (i.e. archeologic sites, land forms, historic sites, soils, and so forth lost as a result of vandalism, overuse, and so forth would be irretrievable losses.

CHAPTER VIII: ALTERNATIVES

The true alternatives discussed in this chapter are the Administrative Alternatives. The production levels are not, strictly speaking, alternatives, but are scenarios, that provide a basis for evaluation to identify areas of environmental concern or impact sensitivity.

This regional EIS evaluates the impacts of projected coal developments in the Southern Utah region. The production level evaluated as most probable is dependent in part on Federal approval of mining and reclamation plans (MRP's) on existing Federal leases. However, the Secretary of the Interior is not proposing a particular production level for coal in this EIS region. Instead, he is considering actions within his authority that will allow Federal coal to be available when needed and under environmentally acceptable conditions to meet market demands and the energy needs of the Nation. The approval actions under review at this time are being considered in this context.

In this regional EIS, decisions regarding MRP's in coal related actions are considered on a regional or subregional basis. Accompanying and future related site-specific statements will evaluate alternatives specific to the individual coal mine proposals. Thus, alternatives for the MRP's in coal related actions are evaluated on an aggregate basis in this statement, providing a means of responding to regional or subregional environmental problems or social and economic concerns.

Development of alternative sources of energy, energy conservation, Federal development of the coal, and emphasis on coal developments in other regions of the United States are more appropriate for consideration on programmatic statements and will be updated and revised as necessary in the new coal programmatic statement now underway.

A. ADMINISTRATIVE ALTERNATIVES

The Secretary's action in regard to the Mining and Reclamation Plans under consideration may be approval as proposed, rejection on various environmental grounds, approval in part, or approval subject to such additional requirements or modifications as he may impose under the law. He may also defer decision pending submittal of additional data, completion of required studies or for other valid reasons. If there are serious environmental concerns as to the coal development, the Secretary may exercise his exchange authority as to the coal rights or seek Congressional action cancelling the Federal leases involved.

B. PRODUCTION LEVEL SCENARIOS

The actual production level obtained in 1990 will depend on demand as well as availability of coal. Factors influencing demand include access and economics in relation to other coal sources, transportation, local as well as Federal approvals, and pollution control requirements and technology. Availability of coal will depend increasingly on Federal approvals as the production level rises. Production greater than the no action level will require Federal approvals of mine and reclamation plans because land ownership patterns make access to much of the State and private coal uneconomical without Federal coal. Further, most of the coal in Utah is in Federal ownership. Production could well occur at significantly lower or higher levels than identified at the projected level. The alternative scenarios provide a display of impact change with less or more production.

1. NO ACTION ALTERNATIVE AND LOW LEVEL SCENARIO (1 mty)

The no action alternative envisages non-approval or rejection of the pending mining and reclamation plans on Federal leases along with any related permits or right-of-ways. Private coal would be developed where support of additional Federal coal is not needed. However Federal coal could be made available to avoid bypass from ongoing private coal development.

Without Federal approval of mining and reclamation plans and associated land use applications future production could reach as much as 1 mty from State and private land (table VIII-1). These are scattered isolated tracts and in most cases could be developed economically only in conjuction with Federal lands.

Impacts related to the no action alternative include:

1. Coal from this area would not be available for any uses. Therefore, coal production either would have to come from elsewhere or a gap in supply would result.

2. Potential for new jobs and business opportunities would be lost in an economically depressed area.

3. The impacts accompanying coal production in this area would be avoided (chapt. IV).

Table VIII-1.--Preliminary mining plans, potential producers by 1990

Proponent	Mine (type)	Proposed Production (mty)	Area (acres)
Fulton and Denton ---------	Shakespear (underground)	0.03	80
Hiko Bell ----------------- Mining & Oil Co.[1]	S. Nipple Butte (underground)	0.5	10,070
King Cannel Coal Co. ------	King Cannel (underground & surface)	0.02	[2]240
Meadowlark Farms[3] ---------	Garfield County (underground & surface)	2.0	11,360
Sunoco Energy Dev. Co. ---- (Sun Oil Co. Delaware)[3]		3.0	18,374
Utah Power & Light Co.[3] ---	Garfield County	4.0	18,325
Woods Petroleum[3] ----------	White Mountain (underground & surface)	5.0	13,609
5 M Corp[4] ----------------	Kaiparowits (underground)	1.0	640

[1]640 acres, preference-right-lease application.
[2]120 acres, private surface.
[3]Preference-right-lease applications.
[4]State land.

The future environment projected to 1990 without the proposed Federal actions but including minor production from State and private lands is analysed in chapter II.

2. MEDIUM PRODUCTION LEVEL SCENARIO (29.3 mty)

This production level is the full production from eight mines proposed in the detailed mining and reclamation plans submitted to GS for approval (table I-1) and associated ancillary facilities (table VIII-2). These proposals are analyzed in detail in part 2.

Attainment of 29.3 mty by 1990 is dependent upon: (1) Federal approval of mining and reclamation plans, (2) approval of land-use applications, (3) development of the proposed Allen-Warner Valley Energy System (A-WV), (4) development of a major transportation system to transport coal from the Kaiparowits Plateau, and (5) securing market for the proposed production from the plateau.

There are several preliminary proposals for transporting coal from the Kaiparowits Plateau (tables VIII-3, 4). Detailed plans have not been developed and right-of-way applications have not been filed for any of these proposals.

a. Geology, Topography, Paleontology

At this level slightly more than 36,000 acres on the Kaiparowits Plateau could be disturbed by subsidence. The potential for mine fires would increase as a result of the increased level of activity.

Both adverse and beneficial impacts will occur to paleontological resources in approximate proportion to the level of regional development and the area disturbed.

b. Soils

The soil impacts from the Alton-Allen-Warner Valley impact area would be the same as under the projected level of production. Additional impacts (compared to the projected level) would occur as a result of increased mining in the Kaiparowits coal field. Impacts are essentially the sum of the impacts discussed in part 2, chapters III and IV of each detailed mine proposal.

The additional soil disturbance on about 2,800 acres for mining activities on the Kaiparowits Plateau would be within Soil Associations 69 and 36 (see chap. II). Unit 69 consists dominantly of rockland, and unit 36 of generally shallow, light-colored soils on plateaus and terraces. These soils are usually dry, annual precipitation is only 8 to 14 inches. Soil materials consist of silty clay where formed from shale, and loamy sand to loam where formed from sandstone.

Table VIII-2.--Medium production level (29.3 mty) summary of facilities

Facility type	Number proposed	Water requirements acre feet/year	Miles	Acreage requirements: Included in project	Disturbed	Reclaimed	Unreclaimed
Water project --------	--	--	--	2,993	1,187	0	1,187
Powerplant -----------	2	39,500	--	10,182	5,475	5,475	0
Mines underground ----	2	4,100	--	2,766	2,766	2,766	0
Mines strip ----------	1	1,416	--	8,920	8,920	8,920	0
Slurry lines ---------	2	8,284	183	2,220	1,100	1,100	0
Powerlines -----------	--	0	70	140	140	140	0
Roads ----------------	--	0	115	530	530	30	500
Added community ------	--	9,160	--	2,437	2,437	0	2,437
Total ------------	--	62,460	--	30,188	22,555	18,431	4,124
Percent of total -----------	--	--	--	100	75	61	14

Table VIII-3.--Preliminary proposed railroads ancillary to mining coal in southern Utah

Proponent	Union Pacific RR Co.	Union Pacific RR Co.	Denver Rio Grande RR	Santa Fe RR Co., Inc.	Utah Power & Light Co.	Denver Rio Grand
Proposal	railroad	railroad	railroad	railroad	railroad	railroad
Map Reference						
Location, Termini or route	Kaiparowitz to Cedar City via East Clarks Bench, Arizona Strip, and Hurricane, Utah	Kaiparowitz to Milford via East Clarks Bench Alton, Panguitch, Minersville	Kaiparowitz to Marysvale via Cockscomb, Henriville, Johnson Valley, Antimony, & Kingston	Kaiparowitz to east of Flagstaff, Arizona	Kaiparowitz to Marysvale via Alvey Wash, Griffen Top, Johnson Valley, Antimony, & Kingston.	Wellington to Hanksville via Castle Valley and IPP proposed route.
Mileage	270 miles	260 miles	104 miles	186 miles	94 miles	65 miles
Acreage Requirement	2,160 acres	2,080 acres	832 acres	1,488 acres	752 acres	520 acres
Mines benefited	Mono 1-5 mines. El Paso Red & Blue mines, Sunoco Energy Develop. mines, Utah Power & Light mines (see comment)	Mono 1-5 mines, El Paso Red & Blue mines, Sunoco Energy Develop. mines, Utah Power & Light mines (see comment). Alton mines	Utah Power & Light mines, Sunoco Energy Development mines, El Paso Red & Blue mines, Mono 1-5 mines	Mono 1-5 mines, El Paso Red & Blue mines, Sunoco Energy Develop. mines	Utah Power & Light mines, Sunoco Develop. mines, El Paso Red & Blue mines, Mono 1-5 mines	Meadow Lark Farm mines in the Henry Mtn. coal field and mines in central Utah
Federal agencies responsible	BLM - right-of-way ICC	BLM - right-of-way USFS - right-of-way ICC	BLM - right-of-way USFS - right-of-way ICC	BLM - right-of-way Bureau of Indian Affairs ICC	BLM - right-of-way USFS - right-of-way ICC	BLM - right-of-way ICC

Table VIII-4.--Preliminary proposed coal slurry lines ancillary to mining coal in southern Utah

Proponent	El Paso Energy Resources Co.	El Paso Energy Resources Co.	El Paso Energy Resources Co.	Utah Power & Light
Proposal	Slurry line	Slurry line	Slurry line	Slurry line
Map Reference				
Termini and (or) route	Kaiparowitz to Cedar City via east Clarks Bench, Arizona Strip, and Hurricane.	Kaiparowitz to east of Flagstaff, Arizona, via Page and Cameron	Kaiparowitz to Walsenburg, Colorado via Page, Arizona, and Farmington, New Mexico	Kaiparowitz to west of Nephi via Escalante
Mileage	163 miles	164 miles	474 miles	151 miles
Acreage	650 acres	655 acres	1,900 acres	600 acres
Mines Benefited	El Paso Red & Blue mines	El Paso Red & Blue mines	El Paso Red & Blue mines	Utah Power and Light mines
Federal Agencies Responsible	BLM - right-of-way BIA - right-of-way	BLM - right-of-way BIA - right-of-way	BLM - right-of-way BIA - right-of-way USFS - right-of-way	BLM - right-of-way USFS - right-of-way
Major Environmental Concerns				
General Comments	Crosses Kaibab Indian Reservation	Crosses Navajo Indian Reservation	Crosses Navajo and Jicarilla Apache Indian Reservations	

Vegetative cover is sparse over the Kaiparowits Plateau and natural soil erosion is quite evident. The sandy soils are most susceptible to wind erosion whereas the clayey soils are more susceptible to water erosion.

During constructional phases the soil erosion rates would increase, but after facilities have been constructed the overall soil movement should be less than under natural conditions as a result of the surface protection offered by the structures.

Some additional soil erosion and land taken out of natural vegetative production would result from the upgrading of haul roads.

About 2,437 acres by 1990 would be needed for community development as a result of increased populations related to mining activities. This compares with about 363 acres needed by 1990 under the projected level of coal production. The additional acreage impacted would almost entirely fall within the Kaiparowits Coal Field influence area, basically from Page, Ariz., to Escalante, Utah.

Community development would result in a use change of the soils from a natural or agricultural system to urban. Sediment production would increase temporarily during construction periods. Wind erosion on sandy soils would probably be the greatest impact to soils and would have local effect on air quality.

c. Water

Impacts on water resources of the mine areas would be very minor, and would involve less than 1 percent of the region. Changes in the chemical quality of water flowing to the Colorado River would be imperceptible.

d. Air

The information presented in this section is a summary of the detailed regional air quality impact analysis presented in Assemblage of Data on Air Quality in Central and Southern Utah and Assessing the Impact of Coal Development in this Region on the Air Quality: Final Report (AeroVironment 1977), modified to take into account changes made since the study was done.

The pollutant sources for each modeling region are shown in table VIII-5. The emissions of particulates, SO_2, and NO_2 for each modeling region are shown in table VIII-6.

The southern area has two main areas with regional impact from particulate emissions--the area around the Alton strip mine, and the South Kaiparowits Plateau. The impact of total suspended particulate (TSP) concentrations from one subregion to adjoining ones is very low due to mixing and fallout over the distances involved.

Table VIII-5.--Breakdown of sources by modeling regions

Modeling region	Sources		
	Mines	Powerplants	Area sources
Escalante area and North Kaiparowits Plateau----------------			Escalante
South Kaiparowits Plateau----------------	El Paso Red and Blue	Navaho	
----------------	Mono 1-5		
Kolob and Skutumpah Terrace, Alton Amphitheater-----------	Alton		Alton Glendale Orderville Hatch Henrieville Tropic
Warner Valley-----------	Warner Valley		

Table VIII-6.--Total emissions by subregion for TSP, SO_2, and NO_2

Region	Source category	TSP	SO_2	NO_2
Escalante Area ------	area sources	7.9	5.5	74.9
& North Kaiparowits Plateau	total	7.9	5.5	74.9
South Kaiparowits ---	mines & roads	9,277	--	--
Plateau	powerplants	2,711	83,667.6	51,263.4
	area sources	--	--	--
	total	11,988	83,667.6	51,263.4
Kolob & Skutumpah ---	mines & roads	5,772	--	--
Terrace, Alton	powerplants	--	--	--
Amphitheater	area sources	86.1	57.4	764.6
	total	5,858.1	57.4	764.6
Warner Valley -------	mines & roads	--	--	--
	powerplants	277.9	2.917.4	14,100.9
	area sources	--	--	--
	total	277.9	2,917.4	14,100.9

Particulate impacts from the Alton mine would be the same as under the projected level.

The South Kaiparowits Plateau region would be impacted by fugitive dust suspension, primarily from travel on unpaved roads. The maximum regional 24-hour TSP incremental increase would be approximately 70 $\mu g/m^3$, which exceeds the class II PSD standard of 37 $\mu g/m^3$.

During periods of high winds background TSP concentrations are above the NAAQS. Incremental TSP concentrations from the mining related sources would be added to the exceedence of the standard caused by wind blown dust.

Impacts from powerplants are the same as discussed under the projected level.

Visibility impacts due to the Alton mining operations would be the same as described under the proposed action. In the South Kaiparowits Plateau region, visibility would be greatly reduced near unpaved roads during and shortly after periods of heavy traffic.

e. Vegetation

Essentially the same kind and level of mitigations would be applied under this production level as under the projected level (12.0 mty). Therefore, residual impacts would be of essentially the same kinds, but of greater extent based on the acres of vegetation affected.

The loss of 22,005 acres of vegetation would result in a loss of about 490 AUM's of domestic livestock forage per year. Over the average 30-year life of the projects, the total livestock forage lost would be 14,700 AUM's. The loss of forest/woodland products would be moderate on a local scale, but minor statewide. Impacts caused by one or more of the conceptual railroad or slurry lines would be similar, but unquantifiable. These impacts would be relatively minor on a regional basis, but may prove major locally.

f. Wildlife and Fisheries

Impacts to wildlife and its habitat would be as described in chapter IV but greater in intensity because of the increased area of disturbance and greater human population increase. Wildlife habitat disturbed would total 22,555 acres. Loss of this amount of habitat would decrease the wildlife population potential for the life of the projects.

Proposed coal mines on the Kaiparowits Plateau would occupy approximately 1,000 acres of deer winter range. A new town on East Clark Bench would occupy approximately 600 acres of antelope range. Conversion of irrigated agricultural lands to housing lots would reduce pheasant habitat by 500 acres. In addition, the demand for second home or recreational developments by the increased population would reduce deer, elk, cougar, turkey, and forest grouse habitat by 130 to 550 acres. About 4,200 acres of wildlife habitat occupied by communities, roads, reservoirs, and recreational developments would be irreversibly committed and long-term wildlife productivity on those lands would be lost. The remaining disturbed areas would be reclaimed following termination of the projects.

Impacts to wildlife from use of 2,437 acres for urbanization would be displacement or elimination of small mammals and a subsequent reduction in use of the area by predators. Responses of bird populations to urbanization would be a decrease in the number of species and an increase in numbers of some species. Species benefitted by urbanization would be omnivores and species that nest on buildings. Species that nest on or near the ground would be eliminated (DeGraff and Thomas, 1976). In Tucson, Ariz., newly created urban habitat had a 26-fold increase in number of individual birds compared to those of the native desert habitat. Exotic (not native) species made up 65 percent of the urban bird population (Emlen, 1974).

Increased traffic would increase wildlife highway mortality. The projected 95 percent increase of traffic on roads where deer kill has been significant would increase deer highway mortality. The average (1975-77) kill of 118 deer per year on these roads would increase to 229 deer per year by 1990. Loss of these deer and their progeny would be irretrievable.

Disturbance, harassment, and illegal killing or collecting of wildlife would increase, and the use of off-road vehicles (ORVs) would contribute significantly to these impacts. Snowmobiles would be used for legal and illegal hunting, fishing, and trapping in areas formerly inaccessible, and game would be harassed by snowmobilers (Stace-Smith, 1975). At the least, harassment would cause increased forage intake and decreased carrying capacity of winter range; at worst, it would cause the death of animals during critical periods (Geist, 1971). Harassment need not be intentional to cause problems. Deer often move out of an area when snowmobiles move in; however, in some areas snowmobile trails are beneficial, allowing deer to move about more freely (Price, 1975). Winter mortality of small mammals would increase in areas under snowmobile compaction (Schmid, 1972). Use of motorcycles, four-wheel drive vehicles, and dune buggies would also impact wildlife. In dense vegetation, areas of greatest vehicle impacts coincide with areas most favorable for wildlife (Miller, 1970). ORVs would impact wildlife directly by killing or injuring individuals and indirectly by destroying nests, cover, and food sources. Studies indicate the diversity, density, and biomass of reptiles, birds, and small mammals are inversely related to the level of ORV use (Bury, and others, 1977). Impacts of ORVs would be pervasive and long lasting because habitats are altered, and rare or unique species with restricted or remote ranges are threatened (Geological Society of America, 1977). Species that would be impacted include the

Utah prairie dog, Gila monster, desert tortoise, desert bighorn sheep, and the bald eagle. The remote character of the area would be irreversibly committed to being more developed with frequent human disturbance. The result would be a long-term reduction of wildlife productivity.

The increased level of mining on the Kaiparowits Plateau would subject a much larger area to subsidence and subsequent loss or alteration of local surface water sources. Loss of surface water and riparian vegetation would reduce available habitat for amphibians, deer, bighorn sheep, and chukar. The number of individuals that would be affected is small, but the loss of habitat would be irreversible.

The accumulation of coal fines, trace elements, heavy metals, salts, and industrial wastes in storage ponds and disposal areas would create a potential for degradation of aquatic habitat in Lake Powell. Such pollutants could be released from spills, calamitous storms, or faulty design of disposal areas. Direct loss of invertebrates or fish, loss of spawning areas, and increased levels of toxic elements would be irreversible impacts that would decrease the long-term productivity of the lake.

A more comprehensive discussion of the impacts on wildlife at the medium production level may be found in part 2 of this environmental statement.

g. Fisheries

At the medium production level of coal mining, impacts to fish described in chapter IV would occur, and these additional impacts would be expected. Fish habitat affected by converting agriculture water to domestic supplies for the new population in the Escalante basin would depend upon the relation of the new diversions to those now used. Moving diversions upstream would adversely affect fisheries; moving them downstream may increase fish habitat; and using present diversions may cause no change. Ammonia and chlorine would probably affect aquatic habitat in the downstream Escalante River not now affected by them. Nonpoint-source sediments would be increased in the Escalante River and Escalante bay of Lake Powell. The population increase with the medium level of coal production would increase the number of resident Utah fishermen by 49 percent over the low level of production and resident Arizona fishermen would increase by 19 percent. Trout streams and several southern Utah reservoirs would be overfished. An increased number of fishermen would fish for warm water species of gamefish, probably at Lake Powell.

h. Lands

The potential Fifty-Mile roadless area is adjacent to the general proposed area of development for Mono Power, and El Paso. Proposed transportation routes have not been specifically designated but would probably cross this potential roadless area. Archeologic values in the area are considered important, and Fifty-Mile-Mountain is being considered for inclusion in the National Historic Register.

At this production level, preliminary plans for coal slurry lines have been proposed to transport coal from El Paso and (or) Mono Power developments (fig. I-1, table VIII-4).

Of transportation routes or utilities, only the existing Navajo-McCulloch powerline crosses the Paria Canyon Primitive Area, the only designated primitive area within the region. Only secondary impacts resulting from the proposed coal developments are expected to influence the Paria Canyon Primitive Area. These include increased recreational usage and human disturbance and possible detrimental effects upon recreational, scenic, historical, and primitive values within the adjacent Paria-hackberry potential roadless area.

i. Socioeconomics

The medium production level scenario differs from the projected level in both the kind and the magnitude of impacts. In 1975 the estimated population of Garfield plus Kane County was nearly 7,000. At the medium level, over 6,000 workers would be employed in coal mining alone by 1990. This is nearly six times the coal employment assumed in the projected level. The relative change would be enormous and would affect Garfield County in particular.

Expansion of coal production could result in 1,174 miners residing in the central Garfield County by 1985, and 1,635 by 1990. As the total enumerated population of that part of Garfield County (the Escalante and Tropic Census County Divisions) was only 1,608 in 1970, the potential magnitude of change is apparent.

In Kane County, a further alternative must be considered. Rather than live in the county, miners who work there may live in Page, Ariz., instead. The high capital costs of extensive new community development in Kane County to provide residences for area miners may be partly avoided or largely postponed if miners commute from Page. Thus, two variations must be considered. One variation assumes no commuting from Page. A second assumes that 90 percent of the Kane County portion of area miners commute from Arizona. Large differences would occur in the effects on Kane County population and economic structure between the variations. Additionally, there are minor implications for the economies of Garfield County and that of the region. These would result from alteration of regional trading relationships.

Projected populations are presented in tables VIII-7 and VIII-8. Coal production at the medium level would produce explosive growth in Kane County during the 1980-85 period. To reach the projected 1985 population an in-migration in five years equal to five times the total

Table VIII-7.--Medium production level population and components of change estimated and projected for subareas of the southern Utah coal EIS region

[Source: 1970; U.S. Census of Population. Projection Years and Intervals for Counties; UPED Model Projections, Bureau of Economic and Business Research, University of Utah. (Detail may not add to totals because of independent rounding)(Thousands of persons)]

County	1970 Population	Interval Components of Change		1975 Population	Interval Components of Change		1980 Population	Interval Components of Change		1985 Population	Interval Components of Change		1990 Population
		Natural Increase	Migration		Natural Increase	Migration		Natural Increase	Migration		Natural Increase	Migration	
Garfield ----	3.2	0.2	+0.1	3.4	0.2	+0.3	3.9	0.3	+9.0	13.2	1.3	+3.2	17.7
Kane --------	2.4	0.1	+1.0	3.6	0.3	+0.4	4.2	0.3	+21.2	25.8	2.9	+7.8	36.5
Total Garfield and Kane --	5.6	0.3	+1.1	7.0	0.5	+0.6	8.1	0.6	+30.2	38.9	4.2	+11.0	54.2
Beaver and Iron ------	16.0	1.4	+1.0	18.4	1.7	+0.9	21.0	1.6	+1.7	24.3	1.4	+0.2	25.9
Washington --	13.7	1.2	+2.1	17.0	2.2	+3.9	23.1	2.4	-3.0	22.5	1.6	-0.7	23.4
Total, Beaver, Iron, Washington --	29.6	2.7	+3.1	35.5	3.9	+4.7	44.1	4.0	-1.3	46.8	3.0	-0.5	49.3
Total, five county-	35.2	2.9	+4.3	42.4	4.4	+5.3	52.2	4.6	+28.9	85.7	7.3	+10.5	103.5

Table VIII-8.--Medium production level population and components of change with commuting from Page, Ariz., estimated and projected for subareas of the southern Utah coal EIS region

[Source: 1970; U.S. Census of Population. Projection Years and Intervals for Counties; UPED Model Projections, Bureau of Economic and Business Research, University of Utah. (Detail may not add to totals because of independent rounding)(Thousands of persons)]

County	1970 Population	Interval Components of Change		1975 Population	Interval Components of Change		1980 Population	Interval Components of Change		1985 Population	Interval Components of Change		1990 Population
		Natural Increase	Migration		Natural Increase	Migration		Natural Increase	Migration		Natural Increase	Migration	
Garfield ---	3.2	0.2	+0.1	3.4	0.2	+0.3	3.9	0.3	+9.0	13.2	1.3	+3.2	17.7
Kane -------	2.4	0.1	+1.0	3.6	0.3	+0.4	4.2	0.3	+7.2	11.7	1.2	+2.8	15.6
Total Garfield and Kane---	5.6	0.3	+1.1	7.0	0.5	+0.6	8.1	0.6	+16.1	24.9	2.5	+5.9	33.3
Beaver and Iron -------	16.0	1.4	+1.0	18.4	1.7	+0.9	21.0	1.6	+1.7	24.3	1.4	+0.2	25.9
Washington -	13.7	1.2	+2.1	17.0	2.2	+3.9	23.1	2.4	-3.0	22.5	1.6	-0.7	23.4
Total, Beaver, Iron, Washington -	29.6	2.7	+3.1	35.5	3.9	+4.7	44.1	4.0	-1.3	46.8	3.0	-0.5	49.3
Total, five county--	35.2	2.9	+4.3	42.4	4.4	+5.3	52.2	4.6	+14.9	71.7	5.5	+5.4	82.6

1980 Kane County population would be required. A population growing at an average rate of 36 percent per year cannot be absorbed and serviced at contemporary standards.

Potential immigration would affect the age composition of the population as shown in tables VIII-9 and VIII-10. The demographic characteristics of areas having high immigration become less like those of the indigenous population and more like those of the immigrants. Lack of mobility of the elderly, plus their inability to respond to changing economic incentives, would result in unusually small proportions of the population 65 years of age and older.

Housing requirements and average household size, consistent with the age composition of the evolving population, are summarized in table VIII-11. The extreme case is that of Kane County. The medium production level would necessitate about 5.7 thousand housing units in 1985. This is 5 1/4 times more than required to meet conditions at the low production level.

For the regional economy as a whole, the projected growth is a much less extraordinary economic experience. Though annual growth rates would be very high for the 1980 to 1985 period, they would be little more than double the regional growth rate projected for 1975 to 1980 (table VIII-12). The real question of impacts associated with coal mining at the medium or high production levels concerns the concentration of the resultant population in the remote and very thinly populated subareas of Kane and Garfield Counties. The total magnitude of change in the regional economy is much less an issue.

The economies of Garfield and Kane Counties would be altered significantly if production at the medium level should occur. In Garfield County, employment in mining would be a major addition to the economic base.

Other important economic effects would result from employment of Arizona residents in Kane County mines (tables VIII-13, VIII-14). If Kane County grows rapidly it will become more self-sufficient in higher order services. This could decrease the demand for such services in Garfield County. To a minor degree, therefore, change in the Garfield County economy may be inversely related to the expansion in Kane County.

A more important consideration concerns the distribution of costs of population support. The potential for adverse impacts is increased if population is concentrated in a thinly developed and sparsely settled area. If much of the population impact were to occur in existing, larger communities (Kane County miners to Page, for example) population support might cost less. The sensitivity of the level and distribution of economic activity in Kane County to commuting from Page is shown in table VIII-14. (Mining employment is in terms of jobs in the county even if held by Arizona residents.) There are substantial differences

Table VIII-9.--Population at medium and high production levels projected by age group counties of Garfield and Kane and remainder of southern Utah coal EIS region

[Source: UPED Model Projection, Bureau of Economic and Business Research, University of Utah. (Details may not add to totals because of independent rounding)(In thousands)]

Age group	Medium production level				High production level			
	1985		1990		1985		1990	
	Reside in Utah	Commute from Page	Reside in Utah	Commute from Page	Reside in Utah	Commute from Page	Reside in Utah	Commute from Page
Garfield County								
0-4 ---	1.13	1.15	1.95	1.96	1.67	1.67	3.71	3.71
5-14---	2.56	2.54	3.25	3.26	4.16	4.16	7.03	7.04
15-24---	3.06	3.05	2.94	2.93	5.17	5.17	7.08	7.07
25-44---	4.17	4.17	6.71	6.71	6.78	6.78	13.91	13.91
45-64---	1.34	1.33	1.74	1.74	1.96	1.96	3.41	3.42
65+ ----	.91	.92	1.08	1.09	1.30	1.30	2.03	2.03
Total-	13.16	13.16	17.68	17.68	21.04	21.03	37.17	37.18
Kane County								
0-4 ---	2.07	1.04	4.07	1.69	1.96	.61	4.33	1.24
5-14---	5.10	2.27	6.66	2.92	5.00	1.16	7.98	3.27
15-24---	6.38	2.64	6.29	2.62	6.23	1.18	7.99	3.43
25-44---	8.48	3.82	14.22	5.90	8.26	1.98	16.09	5.41
45-64---	2.26	1.16	3.34	1.57	2.22	.74	3.87	1.59
65+ ----	1.49	.79	1.90	.93	1.34	.50	2.21	.98
Total-	25.78	11.72	36.48	15.63	25.12	6.18	42.46	15.91
Remainder of southern Utah coal EIS region								
0-4 ---	4.97		4.36		5.12		4.67	
5-14---	9.16		9.76		9.34		10.32	
15-24---	7.00		7.68		7.25		8.37	
25-44---	14.45		15.81		14.82		17.08	
45-64---	5.90		6.06		5.97		6.24	
65+ ----	5.30		5.67		5.38		5.81	
Total-	46.79		49.34		47.88		52.58	

Table VIII-10.--Characteristics of the projected age composition of the medium and high production levels for Garfield County, Kane County, and the remainder of the southern Utah coal EIS region

[Source: UPED Model Projection, Bureau of Economic and Business Research, University of Utah]

	Medium production level				High production level			
	1985		1990		1985		1990	
	Reside in Utah	Commute from Page	Reside in Utah	Commute from Page	Reside in Utah	Comute from Page	Reside in Utah	Commute from Page
				Garfield County				
Percent of population:								
0-15--------------	29.5	29.6	31.0	31.1	29.3	29.3	30.6	30.6
65+ --------------	6.9	7.0	6.1	6.2	6.2	6.2	5.5	5.5
Dependency ratio----	.57	.58	.59	.59	.55	.55	.56	.56
Median age----------	24.6	24.6	26.4	26.4	24.3	24.3	25.7	25.7
				Kane County				
Percent of population:								
0-15--------------	29.4	29.9	31.0	31.1	29.4	30.4	30.7	30.1
65+ --------------	5.8	6.7	5.2	5.9	5.7	8.2	5.2	6.2
Dependency ratio----	.54	.58	.57	.59	.54	.63	.56	.57
Median age----------	24.2	24.7	26.2	26.4	24.2	25.9	25.8	25.1
				Remainder of southern Utah coal EIS region				
Percent of population:								
0-15--------------	31.7		30.3		31.1		30.4	
65+ --------------	11.3		11.5		11.2		11.1	
Dependency ratio----	.76		.72		.74		.71	
Median age----------	27.5		29.1		27.4		28.5	

Table VIII-11.--Housing requirements medium and high production levels for Garfield County, Kane County and the remainder of the southern Utah coal EIS region

[Source: UPED Model Projection, Bureau of Economic and Business Research, University of Utah]

	Medium production level				High production level			
	1984		1990		1985		1990	
	Reside in Utah	Commute from Page	Reside in Utah	Commute from Page	Reside in Utah	Commute from Page	Reside in Utah	Commute from Page
Garfield County								
Occupied dwelling units (in thousands)---	3.67	3.67	5.08	5.08	5.78	5.78	10.46	10.46
Average household size---	3.58	3.58	3.48	3.48	3.64	3.64	3.55	3.55
Kane County								
Occupied dwelling units (in thousands)---	7.03	3.27	10.37	4.49	6.86	1.78	11.96	4.45
Average household size--	3.67	3.58	3.52	3.48	3.66	3.46	3.55	3.58
Remainder of southern Utah coal EIS region								
Occupied dwelling units (in thousands)---	13.98		15.02		14.27		15.90	
Average household size---	3.35		3.28		3.36		3.31	

Table VIII-12.--Projected expansion in regional population and employment, medium and high production levels

[Source: UPED Model Projection, Bureau of Economic and Business Research, University of Utah]

	1975	Interval Growth Rate Percent/ Year	1980	Interval Growth Rate Percent/ Year	1985	Interval Growth Rate Percent/ Year	1990
Medium level:							
Population----	42.43	4.14	52.19	9.93	85.73	3.77	103.49
Labor Force---	16.04	4.31	19.90	10.67	33.92	4.27	42.00
Jobs (Full and Part Time)-	15.70	4.64	19.80	10.98	34.29	4.27	42.46
Proprietor-----	3.05	2.70	3.49	5.35	4.56	2.24	5.10
Wage and Salary	12.66	5.07	16.31	12.01	29.73	4.57	37.36
Medium level with commuting from Page							
Population----	42.43	4.14	52.19	6.34	71.67	2.85	82.64
Labor Force---	16.04	4.31	19.90	6.82	27.98	3.43	33.22
Jobs (Full and Part Time)-	15.70	4.64	19.80	8.85	30.82	3.70	37.09
Proprietor-----	3.05	2.70	3.49	3.27	4.11	1.45	4.42
Wage and Salary	12.66	5.07	16.31	9.86	26.71	4.03	32.67
High level:							
Population-----	42.43	4.14	52.19	11.78	94.04	6.81	132.22
Labor Force ---	16.04	4.31	19.90	12.64	37.44	7.39	54.17
Jobs (Full and Part Time)-	15.70	4.64	19.80	12.95	37.84	7.39	54.76
Proprietor ----	3.05	2.70	3.49	6.54	4.84)	4.50	6.06
Wage and Salary	12.66	5.07	16.31	14.09	33.00	7.78	48.69
High level with commuting from Page							
Population ----	42.43	4.14	52.19	7.28	75.10	6.83	105.67
Labor Force ---	16.04	4.31	19.90	7.83	29.43	7.58	42.99
Jobs (Full and Part Time)-	15.70	4.64	19.80	9.68	32.13	8.00	47.93
Proprietor ----	3.05	2.70	3.49	3.89	4.24	4.12	5.21
Wage and Salary	12.66	5.07	16.31	10.73	27.89	8.53	42.72

Table VIII-13.--Employment (full and part-time) and percentage allocation by sector, medium and high production levels and variations, 1985 and 1990, Garfield County

[Source: UPED Model Projection, Bureau of Economic and Business Research, University of Utah. (Details may not add to totals because of independent rounding) (In thousands)]

	Medium production level				High production level			
	1985		1990		1985		1990	
	Reside in Utah	Commute from Page	Reside in Utah	Commute from Page	Reside in Utah	Commute from Page	Reside in Utah	Commute from Page
Agriculture----	0.28	0.28	0.28	0.28	0.30	0.30	0.33	0.33
Mining---------	1.27	1.27	1.74	1.74	2.71	2.71	5.04	5.02
Construction---	.35	.35	.40	.40	.50	.50	.79	.79
Manufacturing--	.38	.37	.49	.50	.41	.38	.58	.59
TCU[1]-----------	.23	.29	.31	.38	.39	.41	.71	.76
Trade----------	1.38	1.92	1.83	.25	2.05	2.34	3.51	4.22
Fire[2]----------	.22	.30	.31	.43	.35	.40	.66	.78
Services-------	.86	1.01	1.21	1.42	1.20	1.28	2.05	2.32
Government-----	.89	.89	1.24	1.25	1.34	1.35	2.48	2.49
Total-------	5.85	6.68	7.81	6.65	9.25	9.66	16.14	17.31
	Percentage allocation							
Agriculture----	4.8	4.2	3.6	3.2	3.2	3.1	2.0	1.9
Mining---------	21.7	19.0	22.2	19.4	29.3	28.1	31.2	29.0
Construction---	5.9	5.2	5.1	4.4	5.4	5.1	4.9	4.6
Manufacturing--	6.5	5.8	6.2	5.6	4.5	3.9	3.6	3.4
TCU[1]-----------	4.0	4.3	4.0	4.3	4.2	4.2	4.4	4.4
Trade----------	23.6	28.7	23.5	28.4	22.2	24.3	21.8	24.4
Fire[2]----------	3.7	4.5	4.0	4.8	3.8	4.1	4.1	4.5
Services-------	14.7	15.1	15.5	15.9	12.9	13.2	12.7	13.4
Government-----	15.2	13.3	15.9	13.9	14.5	14.0	15.4	14.4

[1]Transportation, communication and utilities.
[2]Finance, insurance and real estate.

Table VIII-14.--Employment (full and part-time) and percentage allocation by sector, medium and high production levels and variations, 1985 and 1990, Kane County

[Source: UPED Model Projection, Bureau of Economic and Business Research, University of Utah. (Details may not add to totals because of independent rounding) (In thousands)]

	Medium production level				High production level			
	1985		1990		1985		1990	
	Reside in Utah	Commute from Page	Reside in Utah	Commute from Page	Reside in Utah	Commute from Page	Reside in Utah	Commute from Page
Agriculture----	0.22	0.19	0.24	0.19	0.22	0.17	0.26	0.19
Mining---------	3.35	3.34	4.54	4.53	3.24	3.23	5.60	5.58
Construction---	.58	.38	.74	.40	.58	.30	.87	.43
Manufacturing--	.21	.14	.29	.18	.21	.11	.32	.18
TCU[1]-----------	.58	.35	.90	.56	.57	.33	1.03	.64
Trade----------	2.36	.66	3.35	.86	2.30	.44	3.84	.87
Fire[2]----------	.42	.12	.65	.18	.41	.08	.75	.19
Services-------	1.30	.61	1.97	.87	1.27	.46	2.18	.91
Government-----	1.55	.73	2.36	1.05	1.51	.41	2.74	1.06
Total-------	10.57	6.53	15.04	8.81	10.30	5.52	17.59	10.05
	Percentage allocation							
Agriculture----	2.1	2.9	1.6	2.2	2.1	3.2	1.5	1.9
Mining---------	31.7	51.2	30.2	51.4	31.4	58.4	31.9	55.5
Construction---	5.5	5.8	4.9	4.6	5.6	5.4	4.9	4.3
Manufacturing--	2.2	2.2	1:9	2.1	2.0	1.9	1.8	1.8
TCU[1]-----------	5.5	5.4	6.0	6.4	5.5	5.9	5.9	6.3
Trade----------	22.3	10.1	22.2	9.7	22.3	7.9	21.9	8.7
Fire[2]----------	4.0	1.9	4.3	2.0	4.0	1.4	4.3	1.9
Services-------	12.3	9.3	13.1	9.8	12.3	8.4	12.4	9.0
Government-----	14.7	11.2	15.7	11.9	14.6	7.4	15.6	10.6

[1]Transportation, communication and utilities.
[2]Finance, insurance and real estate.

in total jobs, but even greater variations in jobs existing to serve requirements of the local population between the levels of production. The greater the commuting from present population concentrations with absorption capacity, the less the capital requirements of creating new capacity. And, the fewer the in-migrants to small towns and hamlets, the less the adverse impact on such vulnerable groups as the elderly.

The effects of the medium level of population and economic activity on municipal services can be found in the tables in Socio-economics, chapter IV.

j. Transportation and Utilities

At the medium production level, ten and one-half mty of coal would be produced by the Alton mine for the Allen-Warner Valley Energy System, so that this part of the scenario would not be changed from the projected level scenario, and transportation effects would be the same.

The remaining 18.8 mty would come from the south end of the Kaiparowits Plateau. It has been estimated that coal production off the plateau must ultimately reach 30 to 40 mty to make railroad construction feasible (verbal communication with Union Pacific Railroad Co.).

Table VIII-15 presents projected traffic for the medium production level on the highway segments marked in figure IV-5. These projections assume that coal would be transported by some means other than truck. Compared over all 27 selected segments, the traffic level projected is approximately 1.7 times the level for the projected production level. Impacts described in chapter IV as resulting from traffic increases would also occur, but to a somewhat greater degree.

Traffic would require the addition of two travel lanes to U.S. Highway 89 from the Arizona state line to the proposed new town. Depending on the extent to which mine workers reside in the vicinity of Page, similar improvements may be needed in Arizona between the State line and Page. This would result in the existing two lane bridge over the Colorado River becoming a bottleneck during periods of peak traffic flow.

Mining 18.8 mty from underground mines in the Kaiparowits Plateau would generate average daily traffic of 6,200 vehicles, including 750 service trucks. Although this traffic could be accommodated on a modified version of the proposed access road, congestion would be a problem, particularly during shift changes.

Traffic demands would also require the addition of climbing lanes from the site of the new town west to Mt. Carmel Junction and improvements to the U.S. Highway 89 - State Road 2777 intersection at Glen Canyon City, such as the addition of turning lanes.

Table VIII-15.--Projected average daily traffic (ADT) levels on selected segments of Utah highways, medium production level (29.3 mty)

Segment[1]	1975 ADT	1980 ADT	1985 ADT	1990 ADT	1990 Trucks
1-------	5,580	7,148	7,498	7,846	1,343
2-------	0	--	--	100	0
3-------	4,660	5,970	6,262	6,553	1,103
4-------	4,940	5,726	6,694	7,098	1,120
5-------	4,000	4,636	5,419	5,747	1,069
6-------	4,275	4,954	6,114	6,611	1,256
7-------	300	325	1,099	1,494	179
8-------	1,390	1,505	3,590	4,737	818
9-------	415	474	1,790	2,466	345
10-------	290	331	1,238	1,678	235
11-------	125	143	604	827	99
12-------	0	--	--	604	0
13-------	1,475	1,719	4,777	6,321	814
14-------	355	415	1,632	2,405	236
15-------	1,650	1,924	5,345	7,073	922
16-------	810	1,090	1,410	1,673	104
17-------	135	121	468	643	30
18-------	20	18	582	608	0
19-------	30	38	129	148	6
20-------	1,590	2,002	5,113	7,025	843
21-------	1,020	1,230	3,282	4,728	671
22-------	890	1,073	3,269	4,801	674
23-------	890	--	--	8,622	1,857
24-------	55	--	--	7,503	842
25A------	0	--	--	5,703	752
26-------	0	--	--	604	0
27-------	20	25	100	120	0

[1]See map, figure IV-5.

A main access road built to state highway standards will be constructed from Glen Canyon City to the mine areas. This road would extend to Escalante, so that 10 percent of commuters to the mines would come from Escalante. The State DOT also indicated that, at this level, a road would be desirable between Henrieville and a main access road junction near the El Paso mines. This road would be 28 miles in length and, assuming an average right-of-way of 100 feet, would commit 339 additional acres. Although not included in the traffic computations, it is apparent that such a road would divert at least as many commuters as the route to Escalante, as well as much of the service truck traffic. This may obviate the need for some of the improvements to U.S. 89.

The existing transportation system is inadequate to move 18.8 mty from Kaiparowits mines. An improved system would be needed. Railroads are being considered, see table VIII-3 and figure I-2, however, 18.88 mty could not justify the cost of rail construction.

Three other proposals for moving coal from Kaiparowits Plateau are coal-slurry pipelines to railheads at Cedar City, Utah; Flagstaff, Ariz.; or Walsenburg, Colo. (fig. I-1, table VIII-4). In comparison with other methods of coal transport, coal-slurry pipelines are not flexible. They are designed to provide a specified amount of coal within a narrow range (3.5 to 5 feet per second velocity) between an initial point and an ending one.

Alternative proposals have been presented for bringing in power to the Kaiparowits Plateau from the 230 kV Navajo-Sigurd UP&L transmission line, tapping it in the vicinity of Grosvenor Arch, in Round Valley, or on East Clark Bench southwest of Glen Canyon City. GarKane could also furnish power from a distribution line on East Clark Bench. Firm proposals have not been received. One possibility would be to extend the powerline entirely across the plateau to Escalante, where it would complete a loop with the present distribution line.

GarKane Power Association, Inc., proposes to furnish power via a 138 kV distribution line to Alton mine from a proposed UP&L substation to be constructed 12 miles north of Panguitch, west of U.S. 89.

Telephone service is available in Alton and presumably to the Alton mine. Telephone service is not available across the Kaiparowits Plateau, but it is assumed that it would be made available if needed. No firm plans to provide service or additional service have been received. If wires are used, about 80 miles of right-of-way would be needed on the Kaiparowits Plateau, nearly all within the proposed road corridor.

k. Recreation

Projected increases in recreation visits and visitor days by residents of the region at the 29.3 mty level of production are shown on tables VIII-16 and VIII-17 along with other levels of production analyzed.

Table VIII-16.--Recreation visits (trips) and visitor days use; by residents of the region at the medium level

	Coal production level		
	Present level	No action level (0.0 mty)	Medium level (29.3 mty)
Population of region to support coal production[1]			
1976	48,525	--	--
1985	--	62,810	98,326 [4](35,516)
1990	--	68,096	113,875 (45,579)
Recreation visits by residents[2]			
1976	444,000	--	--
1985	--	574,700	899,700 (325,000)
1990	--	623,100	1,042,000 (418,900)
Recreation visitor days by residents[3]			
1976	1,385,300	--	--
1985	--	1,793,100	2,807,100 (1,014,000)
1990	--	1,944,100	3,251,100 (1,307,000)

[1] Population figures from socioeconomics section.

[2] Average out-of-community but with region recreation trips per household for worst case analysis is 9.15 trips per year.

[3] Visitor days equals 12 hours aggragated by one or more persons. Each out-of-community but within region recreation trip in the worst case averages 3.12 visitor days (37.44 hours).

(Both [2] and [3] are from baseline information calculated from figures in Utah Resident Recreation Travel, 1974, 1975, and 1976, J. D. Hunt, W. H. Becker, M. J. Dalton and S. F. McCool of the Institute for the Study of Outdoor Recreation and Tourism, Utah State University, Logan, Utah 84322.)

[4] Population, recreation visits and recreation visitor days use above the normal increases for 1985 and 1990 as a result of increased coal production are shown in parentheses.

Table VIII-17.--Out-of-community outdoor recreation trips by residents of the Southern Utah Coal Region[1] medium level

Recreation activity	1976		No action level				Medium level (29.3 mty)			
			1985		1990		1985		1990	
	Percent of total[3]	Number	Projected total	Increase	Projected total	Increase	Projected total	Increase	Projected total	Increase
Driving for pleasure and sightseeing------	21.7	95,500	124,700	29,200	135,200	39,700	195,200	70,500	226,100	90,900
Fishing------------------------------------	15.0	65,800	86,200	20,400	93,500	27,700	135,000	48,800	156,300	62,800
Hiking and back packing-------------------	10.6	46,600	60,900	14,300	66,000	19,400	95,400	34,500	110,500	44,500
Water sports (boating, swim, waterskiing etc.)------------------------------------	9.4	41,500	54,000	12,500	58,600	17,100	84,600	30,600	97,900	39,300
Picnicking---------------------------------	6.9	30,400	39,700	9,300	43,000	12,600	62,100	22,400	71,900	28,900
Skiing-------------------------------------	5.7	25,100	32,800	7,700	35,500	10,400	51,300	18,500	59,400	23,900
Spectator sports (watching sporting events, etc.)----------------------------	4.4	19,300	25,300	6,000	27,400	8,100	39,600	14,300	45,800	18,400
Camping------------------------------------	4.0	17,700	23,000	5,300	24,900	7,200	36,000	13,000	41,700	16,800
4-wheel, motorcycling, ORV use------------	3.7	16,400	21,300	4,900	23,100	6,700	33,300	12,000	38,600	15,500
Hunting big game---------------------------	3.2	14,200	18,400	4,200	19,900	5,700	28,800	10,400	33,300	13,400
Golf---------------------------------------	3.0	13,000	17,200	4,200	18,700	5,700	27,000	9,800	31,300	12,600
Hunting small game and target shooting----	2.1	9,400	12,100	2,700	13,100	3,700	18,900	6,800	21,900	8,800
Winter sports (snowmobiling, ice skating, tubing, etc.)---------------------------	2.1	9,500	12,100	2,600	13,100	3,600	18,800	6,700	21,900	8,800
Other (rockhounding, gathering resource products, nature study, etc.)[2]----------	8.2	35,600	47,000	11,400	51,100	15,500	73,700	26,700	85,400	34,300
Totals--------------------------------	100.0	440,000	574,700	134,700	623,100	183,100	899,700	325,000	1,042,000	418,900

1 Refer to figures I-1 and II-21 for an outline of the Southern Utah Coal Region and the Southern Utah Coal Region Recreation Influence Zone. Text defines differences.

2 Participation by present population during sample period was less than one-half of one percent in any one activity.

3 Individuals may or may not have participated in more than one activity, as listed, during each trip. Figures shown are for major purpose of trip and total 100%; as an example, trip may have primarily been for fishing and recorded as such; however, several other activities may have occurred on the same trip. No time element is involved in this summary sheet.

Based on information from Utah Resident Recreation Travel, 1974, 1975, 1976, Institute for the Study of Outdoor Recreation and Tourism, USU, Logan, Utah, by J. D. Hunt, W. H. Becker, M. J. Dalton and S. F. McCool.

Lands that would be occupied at the 29.3 mty per year level are similar in recreation value, user attractions and recreation use rates (i. e. few or no developed recreation sites, minimal recreation user attractions, and very light (non-impactive) on-site recreation use) as those for the projected level (12.0 mty) of production. Some use is made of the area for: a) driving for pleasure on low standard roads (usually by 4-wheel drive outfits), b) sightseeing, c) gathering resource products, and d) very limited hunting for big and small game.

Impacts resulting from the 29.3 mty production level would be: a) More intensified use of regional recreation attractions listed in tables II-32 and II-33 and as projected in tables IV-20. IV-21 and IV-22. b) More restrictions and regulations on recreation use and activities (see chapt. VI). c) Further reduction in fisherman success and possible hunting success. d) Additional ORV use and resultant impacts. e) Increased recreation user dissatisfaction with over-crowded conditions on roads and of recreation areas and facilities.

l. Archeology and History

Archeologic and historic values would be benefited or lost depending on the extent to which sites were found and properly evaluated in the process of mine or ancillary facility development. The increased population would increase disturbance of sites and would place even more remote sites under direct pressure resulting in some archeologic and historic values being lost.

m. Esthetics

Coal production at any level above the projected production level of 12.0 mty would require additional and extended ancillary facilities and population to support increased mining activities. Impacts to the esthetic resource would be the same as those described in chapters IV and V, but to a greater degree. More urbanization would take place in adjacent communities, and more man-made intrusions would be introduced into the landscape character.

Of greater significance, the regional area affected by additional production would expand to involve the Escalante, Tropic and Panquitch areas in Southern Utah. Impacts to these communities and to adjacent land would be the same as described in chapters IV and V.

3. HIGH PRODUCTION LEVEL SCENARIO (46 mty)

Raising Southern Utah's coal production to 46 mty would require Federal action to approve the detailed mining and reclamation plans submitted to GS for approval (table I-1). It would require submission and approval of mining and relamation plans for the preliminary coal mining proposals involving Federal leases, preference-right-lease applications and State and private land. It would also require the approval of filed and future rights-of-way applications for off-lease ancillary facilities associated with the mines (table VIII-18). The relative locations of the proposed mines at this production level are shown on figure I-2.

In addition to the approval of mine and reclamation plans, markets would need to be developed. UP&L and Utah Resources, International, Inc. et al. (UPB) have each proposed electric power-generating plants near Esclante, Utah. Proposed Nephi and Axtell powerplants by UP&L are outside the ES boundries but are potential markets for Kaiparowits Plateau coal. There is potential for a coal-gasification plant in Southern Utah (table VIII-19). This would probably be beyond the timeframe of this analysis.

The movement of large quantities of coal from the Kaiparowits Plateau would require a major transportation system. Several preliminary proposals have been made and are summarized in tables VIII-3 and VIII-4. Preliminary proposed roads ancillary to mining coal are shown on table VIII-20. Not all of those proposed transportation facilities would be required to reach the 46 mty coal production level. Analysis of cumulative environmental impact are based on data presented in table VIII-18.

a. Geology, Topography, Paleontology

Surface disturbances that would result from underground mining at this level are unknown. Subsidence would occur over mine workings, and, in some areas, potential for mine fires would be increased over that of the medium production level.

Both adverse and beneficial impacts will occur to paleontological resources in approximate proportion to the level of regional development and the area disturbed.

b. Soils

Implementation of mining at the 46 mty level would result in much more soil disturbance than the projected or medium levels. A major factor would be adding two more strip mines, which could disturb as much as 13,700 acres. Reclamation success would be difficult to achieve over much of this area, especially where annual precipitation is less than 12 inches as in the Henry Mountain coal field. Wind erosion would be a problem as sandy soils are common.

With the projected increase in population of 144,535 people by 1990 as a result of this production level, 4,100 additional acres would be needed for community development. Soil impacts would be similar to those discussed under the other alternatives but of greater magnitude, in proportion to the increased acreage of disturbance.

Additional disturbance by railroads, coal-slurry lines, and

Table VIII-18.--High production level scenario (46.0 mty) of mine and related facilities

Facility type	Number proposed	Water requirements acre feet/year	Miles	Acreage requirements Included in project	Distrubed
Water project----	1	--	--	2,943	[1]1,187
Powerplant-------	4	53,000	--	14,000	9,000
Mines:					
underground----	15	8,000	--	3,100	3,100
strip----------	4	1,500	--	26,000	26,000
Slurry pipelines-	3	12,400	657	7,900	4,000
Powerlines-------	2	0	100	210	210
Roads------------	2	0	120	720	[1]720
Railroads--------	1	0	270	2,160	2,160
Added community--	1	15,330	--	4,104	[1]4,104

[1]Probably unreclaimed.

Table VIII-19.--Preliminary proposed coal energy conversion plants, high production level

Proponent	El Paso Energy Resources Co.	Utah Power & Light	U. P. B. 1/	Utah Power & Light	Utah Power & Light
Proposal	Kaiparowits Gassification Plant	Garfield Power Generating Plant	Power Generating Plant	1,000 MW Axtell Generting Plant	1,000 MW Nephi Power Generating Plant
Map Reference					
Location	120 miles NE of Kanab, Utah on 4 mile bench.	8 miles south of Escalante in Avley Utah	4 miles southeast of Escalante on the north side of State Highway 2.	1 mile south of Axtell Utah	10 miles west of Nephi Utah in Dog Valley
Acreage		2,000 acres	2,000 acres	2,000 acres	4,000 acres
Mines Benefited	El Paso Red & Blue mines primarily - other Kaiparowitz mines secondarily	Utah Power & Light mines primarily - other Kaiparowitz mines secondarily	Sunoco mines, El Paso Red & Blue mines and other Kaiparowitz mines to some extent.	Utah Power & Light mines at Kaiparowitz	Utah Power & Light mines at Kaiparowitz
Federal Agencies Responsible	BLM - lease EPA FAA US Army Corp of Engineers	BLM - lease NPS	BLM - lease		
Major Environmental Concerns					
General Comments	This would necessitate subsequent pipeline(s) construction to carry the gas to market(s)				

1/ U. P. B. = Utah Resources International, Phelps Dodge, and Belco Petroleum Corp.

Table VIII-20.--Preliminary proposed roads ancillary to mining coal in southern Utah, high production level

Proponent	Kane County Commissioners	Utah State Department of Highways or Kane-Garfield County Commissioners	Utah State Department of Highways	Utah State Department of Highways	Utah State Department of Highways	Utah State Department of Highways
Proposal	Road	Road	Road	State Route 276 (Study Route 505)	(Study Route 500)	Study Route 506 & State Route 15
Map Reference						
Location, termini and (or) route	Mono #5 mine to Glen Canyon City (US 89) via Warm Springs	Escalante to Glen Canyon City (US 89) via Alvey Wash, Collett Canyons, and Nipple Creek.	Cannonville to Kaiparowitz via Cockscomb	Glen Canyon City to Bullfrog Basin Road	State Route 12 East of Escalante down east side of Straight Cliffs to proposed State Route 276.	From I-15 near Harrisburg to Kanab via La-Verkin and Rockville
Mileage	24 miles	83 miles	40 miles	68 miles	43 miles	58 miles
Acreage	125 acres	430 acres	208 acres	355 acres	225 acres	300 acres
Mines benefited	Mono # 5 mine 5M Corp. mine Hiko Bell mine	El Paso Red & Blue mines, Sunoco Energy Development mines, Utah Power & Light mines, Mono 1-4 mines.	El Paso Red & Blue mines, Sunoco Energy Development mines, Mono 1-4 mines, Utah Power & Light mines.			
Federal agencies responsible	BLM - right-of-way NPS	BLM - right-of-way Bureau of Public Roads	BLM - right-of-way Bureau of Public Roads	BLM - right-of-way NPS Bureau of Public Roads	BLM right-of-way NPS Bureau of Public Roads	BLM - right-of-way Bureau of Public Roads
Major environmental concerns	Road width and alignment constrained by Park Service Policy on the section crossing Glen Canyon NRA.			Road width and alignment constrained by Park Service Policy on the section crossing Glen Canyon NRA.		
Comments		These roads were included as a part of the initial Kaiparowitz submission as proposed State roads. The roads may be initially constructed as county roads and converted to State Highways as use increases.		These roads will be of benefit to all of the mines in the Kaiparowitz coal field because they will provide better inter-city transportation for residents and service or supply vehicles supporting the communities. They are included in the Utah State Department of Highways Functional Classification and Needs Report 1972-1995, adopted June 23, 1972.		

two possible powerplants would cause soil erosion and reductions in land productivity that cannot be quantified as the locations of these activities are not precise, and onsite soils information is not available.

c. Water

Mining-related activities and subsidence could disrupt saturated sandstones and surface drainage. Although the areas affected would be increased, changes in the hydrologic system of the region would be so small as to be difficult to detect.

d. Air

The information presented in this section is a summary of the detailed regional air quality impact analysis presented in Assemblage of Data on Air Quality in Central and Southern Utah and Assessing the Impact of Coal Development in this Region on the Air Quality: Final Report (AeroVironment 1977), modified to take into account changes made since the study was done.

The pollutant sources for each modeling region are shown in table VIII-21. The emissions of particulates, SO_2, and NO_2 for each modeling region are shown in table VIII-22.

The southern area has three main areas with regional impact from particulate emissions: 1) the area around the Alton strip mine, 2) the Escalante area and North Kaiparowits Plateau, 3) and the South Kaiparowits Plateau. The impact of total suspended particulate (TSP) concentrations from one subregion to adjoining ones is very low due to mixing and fallout over the distances involved.

Particulate impacts from the Alton mine would be the same as those discussed under the projected level.

The South Kaiparowits Plateau region would be impacted by fugitive dust suspension, primarily from travel on unpaved roads. The maximum regional 24-hour TSP incremental increase would be approximately 70 $\mu g/m^3$, which is higher than the class II incremental increase standards of 37 $\mu g/m^3$.

The North Kaiparowits Plateau and Escalante area would also be impacted by fugitive dust suspension, primarily from travel on unpaved roads. The maximum regional 24-hour TSP incremental increase would be approximately 95 $\mu g/m^3$, which exceeds the class II incremental increase standard.

The major sources which affect SO_2 concentration are powerplants. Figure VIII-1 presents the 3-hour SO_2 concentration isopleths. Consistent with the worst case approach, the wind direction, used in the analysis was such that the impacts were maximized by overlapping plumes from powerplants close to each other or such that the maximum impact would

Table VIII-21.--Breakdown of sources by modeling region

Modeling region	Mines	Sources powerplants	Area sources
West slope of Henry Mtns.	Meadowlark Farms		
Escalante area & North Kaiparowits Plateau	Woods Petroleum UP&L-Lieu lands and Garfield Sunoco	Escalante Garfield	Escalante
South Kaiparowits Plateau	El Paso and Blue Mono 1-5 Hiko Bell 5 M Corp.	Navaho	
Kolob and Skumpah Terrace, Alton Amphitheater	Alton King Cannel Fulton and Denton		Alton Glendale Orderville Hatch Henrieville Tropic
Warner Valley		Warner Valley	

Table VIII-22.--Total emissions by subregion for TSP, SO_2, and NO_2

Region	Source category	TSP	SO_2	NO_2
West slope of Henry Mtns.	Mines & roads	2081	-	-
	power plants	-	-	-
	area sources	-	-	-
	total	2081	-	-
Escalante area & North Kaiparowits Plateau	Mines & roads	8752	-	-
	power plants	1222.5	21811.2	50013.0
	area sources	16.6	11.5	157.4
	total	9991.1	21822.7	50170.4
South Kaiparowits Plateau	Mines & roads	13591	-	-
	power plants	2711	83667.6	51263.4
	area sources	-	-	-
	total	16302	83667.6	51263.4
Kolob and Skumpah Terrace, Alton Amphitheater	Mines & roads	5856	-	-
	power plants	-	-	-
	area sources	1238	82.6	1106.1
	total	5979.8	82.6	1106.1
Warner Valley	Mines & roads	-	-	-
	power plants	277.9	2917.4	14100.9
	area sources	-	-	-
	total	277.9	2917.4	14100.9

occur on class I areas. As shown in figure VIII-1, the combination of the Garfield and Escalante powerplants impact Capitol Reef National Park more than the allowable 3-hour SO_2 increment of 25 $\mu g/m^3$.

All class II areas are impacted by less than the 3-hour 24-hour, and annual average standards. In addition, there would be no exceedences of NAAQS.

NO_2 impacts would be primarily associated with powerplants. The maximum annual average NO_2 concentrations would be 15 $\mu g/m^3$, which is well below the Federal standard of 100 $\mu g/m^3$.

Visibility impacts due to the Alton mining operations would be the same as described under the proposed action. In the Escalante area and North Kaiparowits Plateau region and the South Kaiparowits Plateau region, visibility would be greatly reduced near unpaved roads during and shortly after periods of heavy traffic.

e. Vegetation

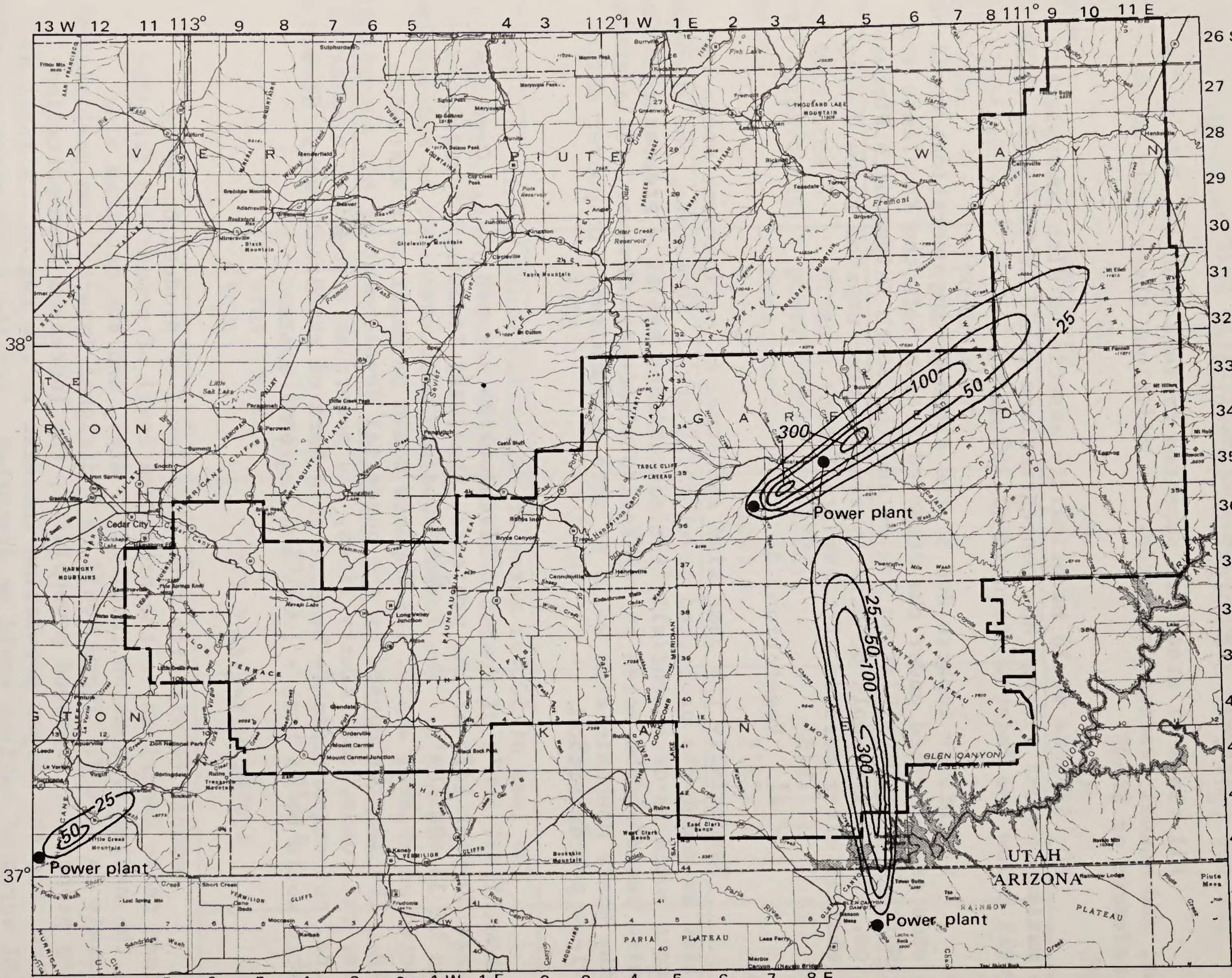
Essentially the same kind and level of mitigations would be applied as under the projected level (12.0 mty). Therefore, the residual impacts would be of essentially the same kinds, but of a greater number or size based on the acres of vegetation affected. However, reclamation of the Henry Mountain area would be more difficult due to poorer soils and less precipitation.

The loss of 50,481 acres of vegetation would result in a loss of about 1,120 AUM's of domestic livestock forage per year. Over the average 30-year life of the projects, the total livestock forage lost would be 33,600 AUM's. The forest/woodland products would be moderately impacted on a local scale, but impacts would be minor on a statewide basis. The impacts caused by the potential development of all conceptual mines, railroads, coal slurry lines, and powerplants would be similar in nature, but unquantifiable because of a lack of essential data. These impacts would be on both a local and regional basis.

f. Wildlife

Impacts to wildlife from this level of production would include those described in the projected level of production (chapter IV), the medium production level (29.3 mty), and the detailed mine proposals in part 2. There would be additional impacts from preliminary mining proposals, proposed powerplants, the increased transportation network, and the larger population increase in the region. A total of 50,481 acres of habitat would be disturbed, and the 6,000 acres occupied by reservoir, roads, and communities would probably not be reclaimed.

The projected population increase, attributable to coal mining and electric-power generation would reduce pheasant habitat by 1,139 acres of irrigated lands converted to housing. A new town on East Clark



Base from U.S. Geological Survey
Arizona, 1974, and Utah, 1969
State base maps 1:500,000

Figure VIII-1.--Maximum 3-hour SO_2 concentration for the high production level for worst-case meteorology in southern Utah.

Bench to house approximately 18,000 new residents would reduce antelope range by 1,000 acres. Increased traffic on roads would increase wildlife highway mortality. The 192 percent increase of traffic on roads where deer are susceptible to road kill would increase deer highway mortality by 224, over the 1975 kill on the same roads. Based on the average deer kill for average traffic, the total annual kill on these roads would be 342 deer by 1990. This figure represents approximately 12 percent of the total harvest in the region during the 1976 deer season.

Illegal activities related to wildlife would increase proportionately with the increase in population. Disturbance, harassment, and displacement from habitat would intensify. Illegal shooting, trapping, and disturbance of wildlife would increase. The endangered bald eagle would be displaced from roost sites in Cedar Valley, Parowan Valley, and Johnson Canyon by urbanization and human disturbance. Shooting and trapping of bald eagles in the U.S. more than doubled from the winter of 1975-76 to the winter of 1976-77, according to the U.S. Fish and Wildlife Service reports (Worthington, 1977). Despite protection by law, killing continues and only 5 percent of bald eagle cases investigated result in prosecution.

Increased development and human disturbance in formerly undisturbed areas would affect Utah Division of Wildlife Resources' (UDWR) plans for transplanting wildlife species. Such development could halt the transplanting of bighorn sheep on areas of the Kaiparowits Plateau, antelope on Panguitch Bench, and elk on the Paunsaugunt Plateau.

The demand for recreational lots would irreversibly decrease wildlife habitat. Based on the present demand in Utah, the increased population attributable to this level of production would own recreational homes that would occupy 230 to 921 acres of wildlife habitat.

Major impacts attributable to preliminary proposals included in this level of production are:

1. Fulton and Denton (Shakespear mine)--This proposed mine would encroach on antelope and sage grouse habitat in Johns Valley. Truck haulage of coal, and commuting miners would increase traffic in an area of deer winter range, and the road kill of deer would increase.

2. Hiko Bell--The area of the proposed mine is historical bighorn sheep range. Development of the area for mining would halt use of the area by sheep for the life of the mine. Disturbance from mining activities may limit antelope use of Nipple and Tibbet springs. This would reduce effective use of their range and limit the potential for developing a herd in the area.

3. King Cannel--Operation of this mine would displace mule deer and cougar from a part of their winter range. This reduction of range would lower the population potential for these species. The proximity

of the portal and coal treatment area to the North Fork of the Virgin River would create a potential pollution source that could adversely affect terrestrial and aquatic species dependent on that water source.

4. Meadowlark Farms--Proposed strip mining of 11,360 acres would destroy 6,240 acres of bison winter range (8 percent of the total). Approximately 1,000 acres of deer winter range (1 percent of the total) would also be destroyed. This range loss would continue until reclamation becomes effective. The viability of revegetation in this area is questionable. The low annual precipitation, and shallow, saline soils may preclude revegetation of part of the area. For effective reclamation the average annual rainfall should exceed 9 inches, and soluble salts in soils should not exceed 1 percent. The presence of salt desert shrubs on Wildcat Mesa indicates saline soils, and the average annual rainfall is only 8 inches; therefore this area may be irreversibly lost as deer and buffalo range. Reclamation success on Swap Mesa and Cave Flat may be adequate; however the EMRIA study of the Alton site (with 16 inches annual precipitation) indicated success in only 1 year out of 3 (BLM, 1975). If reclamation of these areas is unsuccessful, buffalo and deer winter range would be lost or reduced in value. The impact would be loss of animals during critical winter periods when snow depths exclude them from other winter range. The projected population growth in Wayne County would increase recreation use on the Henry Mountains, and legal and illegal killing or disturbance of wildlife would increase. Such activities would lower the population potential of wildlife in this area of limited habitat.

5. Sunoco--This proposed mine would encroach on an area of deer winter range. The proposed seven-mile conveyor could be a barrier to deer movement. The mine would also disturb cougar, cottontail, mourning dove, and raptor habitat in Right Hand Collett Canyon. There would be a local reduction of these species that would continue for the life of the mine.

6. Woods Petroleum--Approximately 13,600 acres of deer winter range would be affected by this proposal. This represents 2 percent of the total on Herd Unit 51B. Of more importance is the fact that 1,900 acres would be strip mined, and 1,600 acres of that total would be in critical deer winter range. This range would be lost until reclamation becomes effective, and a reduction in deer population potential would continue until present productivity is restored. The area of the mine would include the home ranges of at least three cougar, and their potential productivity would also be lost or reduced. From 1971 to 1977 this area (herd unit 51B) provided 3.6 percent of the total cougar harvest in the State. Elk are expanding into the area from nearby herds; however, operation of the proposed mine may preclude establishment of an elk herd in this area. Truck haulage of coal on U-12 and traffic increases related to mining would increase deer highway mortality.

The conceptual coal transportation facilities proposed for the region would adversely affect wildlife. Railroads would permanently occupy wildlife habitat at a rate of 18 acres per mile (based on an average 150 foot right-of-way). Wildlife species that would be affected include, deer, antelope, sage grouse, and Utah prairie dog. Loss of this habitat would continue for the life of the railroads. There would be some loss of individuals by train strikes. Nocturnal species such as owls are susceptible to this type of mortality. In England, railways accounted for 8 percent of reported kills of raptors. Of this total, 64 percent were owls (Weir, 1971). In another study, railways accounted for 10 percent of all reported deaths of owls for the period 1910-1969 (Glue, 1971). Although nocturnal raptors may be the most common victims of railways, a golden eagle feeding on a deer carcass was also killed by a train near Helper, Utah.

Coal slurry pipelines, would occupy wildlife habitat at a rate of 6 acres per mile. Species affected would be small mammals, reptiles and amphibians. Impacts would be temporary, most occurring during construction. Disturbance by maintenance or operating crews may cause abandonment of an area by sensitive species such as cougar, turkey, and raptors. Exportation of water from an area may reduce local supplies to the extent that water becomes unavailable for wildlife. The effect would be reduction of habitat for species dependent on free water sources.

New roads would also encroach on a variety of wildlife habitat. New, or improved, high-speed roads would increase kill of species presently unaccustomed to high-speed traffic. In addition, new roads would bar the movement of some small mammals (Oxley, and others, 1974).

Powerplants proposed would occupy wildlife habitat for the life of the plants. Air, water, and soil pollution, and their accumulative impacts on vegetation, would also adversely affect wildlife. The long-term effects of trace elements and heavy metals on wildlife are not well known, but other compounds in minute quantities have adversely affected some species. The transmission lines associated with the powerplants would benefit raptors and other birds by providing hunting perches and nesting sites. Some birds would be killed by colliding with the towers or lines. Construction and maintenance roads along powerlines may provide access into formerly undisturbed areas. The result would be reduction of habitat for species requiring remote, undisturbed areas. Species that may be affected include elk, cougar, turkey, bighorn sheep, and some raptors.

No additional impacts would be expected to affect endangered St. George or the new snail in Southern Utah if coal is mined at the projected level that was described in chapter IV. However, threats to the St. George snail and new species described in chapter IV would exist if coal is mined at the high production level. Part of the Zion snail's habitat could also be threatened. King Cannel's proposed mine between the North Fork of the Virgin River and Orderville Canyon could disrupt the aquifers contributing water to the hanging gardens. The proposed mine is about 5 miles upstream from Zion National Park. A detailed study of the areas hydrology would be required to adequately assess the threat.

g. Fisheries

At the high production level of mining, the impacts to fishes described in chapter IV and at the medium production level would occur along with the following impacts. Ammonia and chlorine pollution in sewage effluents would be expected to increase in both amount and frequency in all aquatic drainage below sewage outfalls. Non-point source sediments would increase in all fish habitat because of the change in type and amount of land use that would lead to increased sedimentation. Resident Utah fishermen in the study area would increase 99 percent over the base-line population while resident Arizona fishermen would increase by 192 percent. Overfishing of trout streams and small reservoirs would increase, extending beyond the Southern Utah coal region into much of the Southern Wasatch Plateau and northern Arizona regions. More fishing effort would be shifted away from cold water fishes to warm water varieties as trout waters are overexploited. Increased fishing pressure would be expected at Lake Powell and the increased use of fishing boats would cause lead levels in the water to increase in the marina areas.

h. Lands

In addition to the impacts discussed at the 12 and 29.3 mty production levels, the following land impacts would occur at the 46.0 mty level. The UPB Generating Station proposal would be located in a potential roadless area contiguous to Phipps-Hollow and approximately 4 miles south of the Escalante River. The UP&L southern terminus and Sunoco proposals would be in potential roadless areas between Alvey Wash and Straight Cliffs, contiguous to Devil's Garden Outstanding Area. This area is well known for rock hounding and may require protective zoning regulations to control the secondary impact of additional recreational and professional rock hounds and recreationists.

Woods Petroleum Corp. proposal would be located adjacent to a RARE-II designated roadless area on the Dixie National Forest, No. 4258-Henderson Canyon.

The southern tract of Meadowlark Farms PRL's contains three environmental issues of conflict. The tracts, 1) lie within crucial winter range of the Henry Mountain bison herd, 2) provide a visual conflict, as location is 4 miles east of Capitol Reef National Park, and 3) may require transporting coal across parts of Capitol Reef National Park.

Paria and Garfield BLM Planning Unit MFP which includes Shakespear Mine, King Cannel Coal Corp. and Hiko Bell provides the following recommendations:

1) Mining wastes must be kept out of the Paria River bottom.

2) No significant resource conflicts are associated with the Shakespear mine proposed coal development.

3) Archeologic inventories need to be completed before action takes place on the ground for the proposed King Cannel Corp. proposal.

The Escalante Planning Unit, MFP, multiple-use analysis within the planning unit includes the following coal-related impacts associated with UP&L, Sunoco, UPB, and Woods Petroleum conceptual plans: 1) additional access, drill sites, and mine openings would impact watershed values and established seedings and would require proper location and rehabilitation; 2) the proposed utility corridor must insure watershed protection measures and raptor protection measures; 3) the UP&L power-generation sites would reduce grazing carrying capacity of the allotment by 750 acres and would remove mule deer winter range; 4) development of the proposed coal operations would result in increased land speculation.

At this production level, the conceptual railroad to Marysvale from El Paso and Mono Power would cross the general region of the upper Paria-Hackberry potential roadless area and Four-Mile Bench potential roadless area and would be adjacent to the Forest Service designated RARE-II Table Cliffs roadless area. Potential routes for the conceptual railroad to Cedar City from El Paso and Mono Power via East Clark Bench would pass through the NRA and the lower Paria-Hackberry potential roadless area. Land-use regulation to insure protection of fragile and unique areas not classified as wilderness or roadless potential areas are recommended for Eckhart Cliffs and lakes surrounding Alton.

The potential routes to Milford from Alton do not cross any potential wilderness or potential roadless areas.

i. Socioeconomics

The high production level scenario differs from the projected level in both the kind and magnitude of impacts. Impacts at the high level are of the same nature as those of the medium level but are of greater magnitude in proportion to the larger population involved. General descriptions of impacts common to both the medium and high levels were discussed in the medium level scenario and are not repeated here.

In 1975 the estimated population of Garfield plus Kane County was nearly 7,000. At the high production level, over 10,000 workers would be employed in coal mining alone by 1990. This is nearly ten times the coal employment assumed in the projected level. The relative change would be enormous and would affect Garfield County in particular.

Expansion of coal production could result in 2,580 miners residing in the central Garfield County by 1985, and 4,855 by 1990. As the total enumerated population of that part of Garfield County (the Escalante and Tropic Census County Divisions) was only 1,608 in 1970, the potential magnitude of change is apparent.

Projected population, broken down to subareas, is presented in table VIII-23. Table VIII-24 presents subarea projected populations and components of change with commuting from Page, Ariz. Tables VIII-9 through VIII-14, included in the medium level discussion, provide high level scenario information about age groups, age composition, housing requirements, expansion of population and employment, employment by sector in Garfield County, and employment by sector in Kane County.

The effects of the high level of population and economic activity on municipal services can be found in the tables in Socio-economics, chapter IV.

j. Transportation and Utilities

Projections of the levels of traffic associated with this scenario are presented in table VIII-25. When compared over all 27 segments, there would be 2 1/2 times more traffic with this alternative than with the probable level. Impacts resulting from increased traffic that were described in chapter IV would also occur with this alternative to a much greater degree.

To accomodate these traffic levels, certain highway improvements would be necessary. The Utah DOT expects that U.S. 89 would have to be upgraded by the addition of two travel lanes from the Arizona State line near Page to State Route 15. Similar improvements would be necessary to U.S. 89 in Arizona between the State line and Page, with somewhat lesser improvements necessary to U.S. 89 between Page and Flagstaff. As with the medium production level, the existing two lane bridge over the Colorado River would serve as a bottleneck during the peak periods of traffic flow. The intersection of Utah State Route 277 with U.S. 89 would also have to be improved to include center islands and turning lanes.

The production from the Alton coal field is assumed to hold steady at 10.5 mty under this scenario, so that environmental effects will remain the same.

Assuming 2.0 mty are produced from the Henry Mountains area; truck haul over the Notom Road along the east side of Capitol Reef National Park and partly in it may be required. As this is a proposed strip mine operation, only about 120 employees would be needed to mine the coal, but about 300 would be needed to truck it.

If the proposed IPP powerplant is not built at the Salt Wash site and considering the bottleneck in trying to move heavy trucks through the Capitol Reef National Park, the only feasible haul to

Table VIII-23.--High production level population and components of change estimated and projected for subareas of the southern Utah coal EIS region

[Source: 1970; U.S. Census of Population. Projection years and intervals for counties; UPED Model Projections, Bureau of Economic and Business Research, University of Utah. (Detail may not add to totals because of independent rounding)(Thousands of persons)]

County	1970 Population	Interval Components of Change		1975 Population	Interval Components of Change		1980 Population	Interval Components of Change		1985 Population	Interval Components of Change		1990 Population
		Natural Increase	Migration		Natural Increase	Migration		Natural Increase	Migration		Natural Increase	Migration	
Garfield---	3.2	0.2	+0.1	3.4	0.2	+0.3	3.9	0.3	+16.8	21.0	2.3	+13.8	37.2
Kane-------	2.4	.1	+1.0	3.6	.3	+ .4	4.2	.3	+20.6	25.1	2.8	+14.2	42.5
Total, Garfield and Kane------	5.6	0.3	+1.1	7.0	0.5	+0.6	8.1	0.6	+37.4	46.2	5.1	+28.4	79.6
Beaver and Iron------	16.0	1.4	+1.0	18.4	1.7	+0.9	21.0	1.6	+2.8	25.0	1.6	+1.5	28.1
Washington-	13.7	1.2	+2.1	17.0	2.2	+3.9	23.1	2.4	-2.6	22.9	1.6	0	24.5
Total, Beaver, Iron, Washington-	29.6	2.7	+3.1	35.5	3.9	+4.7	44.1	4.0	-0.2	47.9	3.2	+1.5	52.6
Total, Five county-	35.2	2.9	+4.3	42.4	4.4	+5.3	52.2	4.6	+37.2	94.0	8.3	+29.9	132.2

Table VIII-24.--High production level population and components of change with commuting from Page, Ariz., estimated and projected for subareas of the southern Utah coal EIS region

[Source: 1970; U.S. Census of Population. Projection years and intervals for counties; UPED Model projections, Bureau of Economic and Business Research, University of Utah. (Detail may not add to totals because of independent rounding)(Thousands of persons)]

County	1970 Population	Interval Components of Change		1975 Population	Interval Components of Change		1980 Population	Interval Components of Change		1985 Population	Interval Components of Change		1990 Population
		Natural Increase	Migration		Natural Increase	Migration		Natural Increase	Migration		Natural Increase	Migration	
Garfield---	3.2	0.2	+0.1	3.4	0.2	+0.3	3.9	0.3	+16.8	21.0	2.3	13.8	37.2
Kane-------	2.4	.1	+1.0	3.6	.3	+ .4	4.2	.3	+1.6	6.2	.5	+9.3	15.9
Total, Garfield and Kane-----	5.6	0.3	+1.1	7.0	0.5	+0.6	8.1	0.6	+18.5	27.2	2.8	+23.1	53.1
Beaver and Iron-----	16.0	1.4	+1.0	18.4	1.7	+0.9	21.0	1.6	+2.8	25.0	1.6	+1.5	28.1
Washington-	13.7	1.2	+2.1	17.0	2.2	+3.9	23.1	2.4	-2.6	22.9	1.6	0	24.5
Total, Beaver, Iron, Washington-	29.6	2.7	+3.1	35.5	3.9	+4.7	44.1	4.0	-0.2	47.9	3.2	+1.5	52.6
Total, Five county-	35.2	2.9	+4.3	42.4	4.4	+5.3	52.2	4.6	+18.3	75.1	6.0	+24.6	105.7

Table VIII-25.--Projected average daily traffic (ADT) levels on selected segments of Utah highways, high production level (46 mty)

Segment	1975 ADT	1980 ADT	1985 ADT	1990 ADT	1990 Trucks
1----------	5,580	7,148	7,687	8,416	1,440
2----------	0	--	--	100	0
3----------	4,660	5,970	6,420	7,029	1,184
4----------	4,940	5,726	6,943	7,804	1,232
5----------	4,000	4,636	5,621	6,319	1,175
6----------	4,275	4,954	7,788	8,466	1,609
7----------	300	325	2,810	3,797	456
8----------	1,390	1,505	5,474	9,632	1,663
9----------	415	474	--	6,448	987
10----------	290	331	--	3,882	776
11----------	125	143	--	2,232	625
12----------	0	--	--	4,704	697
13----------	1,475	1,719	6,778	11,673	1,503
14----------	355	415	2,626	3,045	298
15----------	1,650	1,924	7,584	13,061	1,702
16----------	810	1,090	1,415	1,874	114
17----------	135	121	468	643	30
18----------	20	18	582	608	0
19----------	30	38	129	154	6
20----------	1,590	2,002	5,058	8,048	974
21----------	1,020	1,230	3,230	5,666	805
22----------	890	1,073	3,214	5,822	818
23----------	890	--	--	10,743	2,305
24----------	55	--	--	8,246	1,016
25A---------	0	--	--	6,446	926
26----------	0	--	--	951	0
27----------	20	--	--	2,000	1,754

railhead would be 106 miles through Hanksville to Green River and the Denver & Rio Grande Western Railroad. A market for this coal has not been identified.

In general, the traffic capacity of State Road U-24 would not be exceeded, although the mine traffic could conflict with recreation oriented traffic. The State DOT, however, indicates that U-24 is structurally inadequate to handle the truck traffic and would have to be rebuilt.

It is assumed that a small amount of coal will be produced in the vicinity of Tropic, but initially, at least, the production would probably not overload the improved gravel road to the portal.

The proposed Woods Petroleum White Mountain Development would be a combined underground and surface mine with its portal initially on U-12 in Upper Valley Creek, a potentially crowded site. It is unlikely that as much as 5 mty can be taken initially from a portal at this location, but a bottleneck is likely to develop in getting trucks onto and off the highway. In the narrow canyon it may be necessary to build acceleration and deceleration lanes. A possibility exists of trucking from Little Valley down the county road paralleling Birch Creek to U-12; however, this is likely to move the bottleneck to the junction of Birch Creek road with U-12. Truck haul would be to a railroad, the most obvious being the proposed spur from the Alton alternative to the UP proposal (see chapt. I). If the UP&L proposed railroad were built, a loadout could be built in Little Valley alongside the tracks, eliminating the trucking problem.

For purposes of the traffic analysis, it was assumed that the coal would be trucked over the county road from U-12 to the Red Canyon Branch of UP's conceptual Milford line. This would require that this road be upgraded to a configuration similar to the access road for the south Kaiparowits Plateau area mines.

Most of the coal to be produced, about 28.5 mty, would come from underground mines on the Kaiparowits Plateau. If production at this level would occur, it could become necessary to construct truck-passing lanes and easy grades across the plateau.

As was discussed in connection with the medium production level, the State DOT would find a route between Henrieville and the El Paso minesite desirable. This would siphon some of the commuter and service truck traffic away from roads in the Escalante area.

The transportation-utility corridor proposed for the Plateau would pass within 7 miles of the center of all the leases on the Plateau except for the small ones in the very southeast corner and would pass less than 5 miles away from most. This permits corridorization of roads, powerlines, and telephone lines, plus any heavy-duty haul roads for off-highway trucks, conveyor systems, or pipelines. Rail access to the plateau must follow its own corridor, due to grade limitations. The small leasees in the southeast corner of the Plateau would be limited to the present road through the northwest corner of the Glen Canyon National Recreation area, with consequent effects on proposed recreation traffic.

Impacts on transportation and utilities would be only an intensification of impacts which would result from development at the projected level. The road would be wider, three lanes in spots, and occupy slightly more area because of the necessity of construction to higher standards, with flatter grades and heavier cuts and fills; however, this additional acreage cannot be quantified short of the preliminary design stage. More traffic would use the road, to the detriment of wildlife and to the inconvenience of highway users. The transportation corridor would be wider, because it would carry conveyor belts or off-highway haul roads, higher-voltage powerlines requiring more right-of-way, and the possibility of water pipelines and (or) coal-slurry pipelines.

It is likely in all these alternatives that any good vehicular access provided to the Kaiparowits Plateau would remain dedicated to that purpose. Even after mining is done, the access provided to the communities in south-central Utah and to the recreational areas would continue demand for maintenance of the road. Because large-scale mining, once started, is likely to extend beyond 40 years, commitments of rights-of-way to coal conveyors, haul roads, powerlines, and so on are likely also to continue past the lifetimes of the mines under consideration here.

Alternative railroads are being considered to move coal from the Kaiparowits Plateau (fig. I-2, table VIII-3).

Construction of a railroad would require coal production of 30 mty or more over a prolonged period to pay the cost of railroad construction.

Movement of coal by rail would most likely be by unit trains. In a strict sense, a unit train is a complete train of dedicated cars operating on a regularly scheduled cycle movement between a single origin and a single destination. A typical coal unit train consists of 100 cars, each capable of carrying 100 tons of coal and four to eight diesel units. Thus, 10,000 tons of coal can be shipped per trip. Shipment of 30 mty would require between eight and nine 100-car unit train round trips daily.

The amount of fuel consumed transporting coal by rail from the southern Utah region would be dependent on numerous factors, many of which are presently unknown. The ultimate coal markets, train routing and type of rail carriage (unit train or general freight) would influence the total amount of fuel consumed, estimated to be 10 million gallons of diesel fuel per 100 miles of shipment.

Primary sources of air pollution associated with coal train movements are pollutants emitted as part of the diesel exhaust, and dust blown from uncovered coal cars. The three primary locomotive emissions are carbon monoxide, hydrocarbons, and nitrogen oxides. These pollutants will increase in raw terms (lbs/mile) as the train frequencies increase. Table VIII-27 gives average emissions for the frequency of service in this alternative. This level of pollutant emissions would be insignificant on regional air quality.

Other impacts associated with rail operations would include noise, accidents and delay.

Rail line operations would create the possibility of highway-rail grade crossing accidents. A 100-car unit train would physically block an intersecting road for approximately 3 1/2 minutes. Warning devices and driver anticipation would further extend the amount of time a particular crossing is closed. In addition to the general inconvenience created by this delay, such blockages could increase response time for emergency vehicles. This unnecessary idling would also be another source of air pollution. Any rail service into the region, however, would have to be as a result of new rail line construction and the major points of potential conflicts as well as causes for delay can be avoided by the construction of grade separations.

Extra regional (down line) rail impacts--Impacts resulting from rail operations would not be confined to the region, but would be manifested, to some degree wherever the coal shipment goes. The generic impacts discussed previously would pertain to rail movement regardless of routing. While the effect of an individual train would not be significant, the repetition of these small impacts may be significant. The major extra-regional implications of the movement of Central Utah coal comes where these movements are added to lines with already high rail traffic.

Presently, the ultimate destinations for most coal produced in the Kaiparowits Plateau under the 46 mty alternative are unknown, making specific point impact analysis outside the region impossible. UP&L would like to consume the coal it produces, which is the premise for its conceptual route. If rail access was such that the coal produced by UP&L was not easily transported to a UP&L powerplant, it may sell the coal on the open market or trade it for coal easier for it to utilize.

k. Recreation

The high production level (46.0 mty) would expand the geographical location for mining coal to include lands on the north end of the Kaiparowits Plateau, the Table Cliffs Plateau, White Mountain and the east side of the Henry Mountains. Consequently the Southern coal region R 12 would be expanded to the north and east (see fig. VIII-1).

Table VIII-26.--Locomotive air pollution emissions

Pollutant	Train frequency per hour	Train frequency per day	Locomotive emissions (avg. lb/mi/hr.)
Carbon monoxide (CO)---	1	18	5.6
Hydrocarbons (HC)------	1	18	4.0
Nitrogen oxides (NO_x)--	1	18	15.0

Impacts similar to those described in chapters IV and V would accrue to the following developed recreation sites listed in tables VIII-27 through VIII-30. The majority of these sites generally receive less use than the sites in the southern portion of the region (tables VIII-27 and VIII-28). However, due to the increased use of the same resources by new residents in the Central Utah coal region, and normal increases in use by 1985 and 1990, the developed sites and use areas listed could be impacted to the same degree as at the 12.0 and 29.3 mty production levels.

l. Archeology and History

Archeologic and historic values would be benefited or lost, depending on the extent to which sites were found and properly evaluated in the process of mine or ancillary facility development. The increased population would increase disturbance of sites and even more remote sites would be visited resulting in some archeologic and historic values being lost.

m. Esthetics

Coal production at any level above the projected production level of 12.0 mty would require additional and extended ancillary facilities and population to support increased mining activities. Impacts to the esthetic resource would be the same as those described in chapters IV and V, but to a greater degree. More urbanization would take place in adjacent communities, and more manmade intrusions would be introduced into the landscape character.

Of greater significance, the regional area affected by additional production would expand to involve the Escalante, Tropic, and Panquitch areas in Southern Utah. Impacts to these communities and to adjacent land would be the same as described in chapters IV and V.

Table VIII-27.--Recreation visits (trips) and visitor days use; by residents of the region at the high level

		Coal production level	
	Present level	No action level (0.0 mty)	High level (46.0 mty)
Population of region to support coal production[1]			
1976	48,525	--	--
1985	--	62,810	102,277 [4](39,417)
1990	--	68,096	144,535 (76,439)
Recreation visits by residents[2]			
1976	444,000	--	--
1985	--	574,700	935,400 (360,700)
1990	--	623,100	1,322,500 (699,400)
Recreation visitor days by residents[3]			
1976	1,385,300	--	--
1985	--	1,793,100	2,918,400 (1,125,300)
1990	--	1,944,100	4,126,200 (2,182,100)

[1] Population figures from socioeconomics section.

[2] Average out-of-community but with region recreation trips per household for worst case analysis is 9.15 trips per year.

[3] Visitor days equals 12 hours aggragated by one or more persons. Each out-of-community but within region recreation trip in the worst case averages 3.12 visitor days (37.44 hours).

(Both [2] and [3] are from baseline information calculated from figures in Utah Resident Recreation Travel, 1974, 1975, and 1976, J. D. Hunt, W. H. Becker, M. J. Dalton and S. F. McCool of the Institute for the Study of Outdoor Recreation and Tourism, Utah State University, Logan, Utah 84322.)

[4] Population, recreation visits and recreation visitor days use above the normal increases for 1985 and 1990 as a result of increased coal production are shown in parentheses.

Table VIII-28.--Out-of-community outdoor recreation trips by residents of the Southern Utah Coal Region[1] high level

Recreation activity	1976		No action level				High level (46.0 mty)			
			1985		1990		1985		1990	
	Percent of total[3]	Number	Projected total	Increase	Projected total	Increase	Projected total	Increase	Projected total	Increase
Driving for pleasure and sightseeing------	21.7	95,500	124,700	29,200	135,200	39,700	203,000	78,300	287,000	151,800
Fishing------------------------------------	15.0	65,800	86,200	20,400	93,500	27,700	140,300	54,100	198,400	104,900
Hiking and back packing-------------------	10.6	46,600	60,900	14,300	66,000	19,400	99,200	38,300	140,200	74,200
Water sports (boating, swim, waterskiing etc.)------------------------------------	9.4	41,500	54,000	12,500	58,600	17,100	87,900	29,300	124,300	65,700
Picnicking--------------------------------	6.9	30,400	39,700	9,300	43,000	12,600	64,500	24,800	91,300	48,300
Skiing------------------------------------	5.7	25,100	32,800	7,700	35,500	10,400	53,300	20,500	75,400	39,900
Spectator sports (watching sporting events, etc.)---------------------------	4.4	19,300	25,300	6,000	27,400	8,100	41,200	15,900	58,200	30,800
Camping-----------------------------------	4.0	17,700	23,000	5,300	24,900	7,200	37,400	14,400	52,900	28,000
4-wheel, motorcycling, ORV use------------	3.7	16,400	21,300	4,900	23,100	6,700	34,600	13,300	48,900	25,800
Hunting big game--------------------------	3.2	14,200	18,400	4,200	19,900	5,700	30,000	11,600	42,300	22,400
Golf--------------------------------------	3.0	13,000	17,200	4,200	18,700	5,700	28,000	10,800	39,700	21,000
Hunting small game and target shooting----	2.1	9,400	12,100	2,700	13,100	3,700	19,600	7,500	27,800	14,700
Winter sports (snowmobiling, ice skating, tubing, etc.)---------------------------	2.1	9,500	12,100	2,600	13,100	3,600	19,700	7,600	27,800	14,700
Other (rockhounding, gathering resource products, nature study, etc.)[2]----------	8.2	35,600	47,000	11,400	51,100	15,500	76,700	29,700	108,300	57,200
Totals------------------------------------	100.0	440,000	574,700	134,700	623,100	183,100	935,400	360,700	1,322,500	699,400

[1] Refer to figures I-1 and II-21 for an outline of the Southern Utah Coal Region and the Southern Utah Coal Region Recreation Influence Zone. Text defines differences.

[2] Participation by present population during sample period was less than one-half of one percent in any one activity.

[3] Individuals may or may not have participated in more than one activity, as listed, during each trip. Figures shown are for major purpose of trip and total 100%; as an example, trip may have primarily been for fishing and recorded as such; however, several other activities may have occurred on the same trip. No time element is involved in this summary sheet.

Based on information from Utah Resident Recreation Travel, 1974, 1975, 1976, Institute for the Study of Outdoor Recreation and Tourism, USU, Logan, Utah, by J. D. Hunt, W. H. Becker, M. J. Dalton and S. F. McCool.

Table VIII-29. Additional developed recreation sites impacted by production of 46 mty

Administering agency or ownership	Developed site name and type	Season of use and length of season	PAOT[1]	1976[2] Recreation visits	1976[3] Recreation visitor days use	1976[4] Use % of capacity	Remarks
Bureau of Land Mgmt.							
Henry Mountains resource area	McMillian Spring campground	--- (120 days)	50	---	200	3%	Light use-fair condition
	Lonesome Beaver campground	--- (120 days)	65	---	400	2%	Light use-fair condition
	Hog Springs campground	1/1 to 12/31(365 days)	30	---	1,100	10%	Light use-fair condition
	Starr Springs campground	--- (240 days)	75	---	8,100	23%	Moderate use-good condition
U.S. Forest Service							
Fishlake Nat'l Forest	Johnson Valley campground	6/1 to 10/15(137 days)	10	3,000	1,500	55%	Parking only-day use
	Gooseberry campground	6/1 to 9/30(122 days)	75	1,800	6,200	34%	Minor rehabilitation needed
	Bowery picnic site	6/1 to 10/15(137 days)	110	4,200	700	5%	Light daytime use
	Mackinaw campground	6/1 to 10/15(137 days)	270	21,600	36,000	49%	Heavy use, minor rehab. needed
	Twin Creeks visitor center	6/1 to 10/15(107 days)	20	2,600	500	20%	Good condition
	Fremont River complex	6/1 to 10/30(152 days)	200	11,200	18,700	31%	Needs minor maintenance
	Elkhorn campground	7/1 to 9/15(77 days)	78	---	3,000	25%	Needs some maintenance
	Sunglow picnic site	5/1 to 11/1(185 days)	57	2,600	2,200	21%	Light use-good condition
	Frying pan campground	6/1 to 10/15(137 days)	55	1,500	3,800	25%	Good condition
	Bowery campground	6/1 to 10/15(137 days)	215	15,800	27,100	46%	Minor rehabilitation needed
	Doctor Creek campground	6/1 to 10/15(137 days)	150	7,500	12,400	30%	Minor rehabilitation needed
	Twin Creeks campground	6/1 to 10/15(137 days)	150	10,400	2,600	13%	Light use-good condition
	Doctor Creek picnic area	6/1 to 10/30(152 days)	150	1,800	4,700	21%	Moderate use-good condition
Dixie Nat'l Forest	Singletree campground	5/25 to 9/15(135 days)	200	10,600	6,300	14%	Moderate use-good condition
	Pleasant Creek campground	5/25 to 9/15(135 days)	95	27,200	11,400	53%	Heavy use-good condition
	Oak Creek campground	5/25 to 9/15(135 days)	50	8,400	5,800	51%	Some heavy maintenance needed
National Park Service							
Glen Canyon Nat'l Recreation Area	Hite marina and campground	1/1 to 12/31(365 days)	30	72,400	---	660%	Extreme spring, summer and fall use-fair condition
	Bullfrog campground and marina	1/1 to 12/31(365 days)	430	121,300	242,600	77%	Heavy spring-fall use, good condition
Capitol Reef Nat'l. Park	Capitol Reef campground	1/1 to 12/31(365 days)	265	30,537	35,600	18%	Heavy summer use-good condition
	Capitol Reef picnic site	1/1 to 12/31(365 days)	100	100,000	8,340	23%	Heavy summer use-good condition
	Capitol Reef visitor center	1/1 to 12/31(365 days)	[5]NA	NA	NA	NA	Heavy use-good condition
Arches Nat'l Park	Devils Garden campground	1/1 to 12/31(365 days)	270	37,900	NA	26%	Moderate use-good condition
	Devils Garden picnic site	1/1 to 12/31(365 days)	85	NA	NA	NA	Moderate use-good condition
	Balanced Rock picnic site	1/1 to 12/31(365 days)	15	1,000	NA	18%	Light to moderate use-fair condition
Canyonlands Nat'l Park	Green River overlook	1/1 to 12/31(365 days)	NA	NA	NA	NA	Moderate use
	Grandview Pt. Picnic site	1/1 to 12/31(365 days)	30	NA	NA	NA	Light to moderate use-good cond.
	Upheaval Dome picnic site	1/1 to 12/31(365 days)	25	NA	NA	NA	Light to moderate use-good cond.
State of Utah-Div. of Parks and Recreation							
	Green River State Rec. Area	1/1 to 12/31(365 days)	250	115,980	use fig.	127%	Heavy use-good condition
	Goblin Valley State Reserve	1/1 to 12/31(365 days)	50	18,020	not calcu-	100%	Good condition
	Deadhorse Point State Park	1/1 to 12/31(365 days)	210	129,230	lated for	295%	Good condition
	Otter Creek Lake State Beach	6/1 to 11/30(183 days)	180	25,470	State facilities	77%	Good condition
	Deadhorse Pt. visitor ctr.	1/1 to 12/31(365 days)	*	*	---	---	Good condition
	Deadhorse Interpretative Museum	1/1 to 12/31(365 days)	*	*	---	---	Good condition

[1]Theoretical developed capacity of developed site, expressed in the number of people the site can accomodate at one time (PAOT).
[2]Recreation visit - one person visiting the site - no time element calculated or involved.
[3]Recreation visitor day use - an aggregate of 12 hours by one or more persons.
[4]Use as a percent of capacity is based on the managed season of use (length of season x PAOT). Well managed sites generally receive between 20% and 40% use. Beyond 40%, sites deteriorate rapidly, require heavy maintenance and user experience levels diminish from overcrowding (i.e. loss of privacy and solitude, increase in noise, disturbances, etc.).
[5]NA - not available or not applicable.
*Included in total for Deadhorse Point State Park.

Table VIII-30.- Additional local, regional and national recreation attractions and use areas impacted by production level of 46.0 mty

Administering agency or ownership	Recreation use area or attraction	Recreation visits[1] or visitor days use[2] (where available)	Major recreation user attractions: Scenery	Driving	Camping	Picnicking	Hiking	Hunting	Fishing	Boating	Swimming	ORV use	Nature study	Cultural history	Archeology	Paleontology	Geology	Wildlife	Snowmobiling	Solitude	Photography	Remarks*
Bureau of Land Management																						
	Henry Mountains	Records not kept	●	●	●	●	●	●				●	●	●	●		●	●		●	●	Heavy use-local light use-spring and fall
	Sinbad Country	Records not kept	●	●	●	●	●	●				●	●	●	●		●	●		●	●	Moderate use-spring and fall on secondary roads and camping
	Labrinth Canyon (Green River)	29,000 V	●		●	●	●	●	●	●	●	●	●	●	●		●	●		●	●	Heavy use-family float boating
	San Rafael Reef	Records not kept	●	●	●	●	●	●				●	●	●	●		●	●		●	●	Moderate-heavy use-spring and fall-ORV use
Estimated visits to all public lands in influence zone administered by Bureau of Land Management		400,000 visits																				
U.S. Forest Service																						
Fishlake National Forest	Fishlake Mountains	570,600 V/D's	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	Heavy use-summer and fall
Dixie National Forest	Thousand Lake-Boulder Mountain	89,100 V	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	Moderate use
National Park Service																						
	Arches National Park	294,800 V	●	●	●	●	●					●	●	●	●		●	●		●	●	Heavy use-spring and fall and increasing
Canyonlands National Park	Green & Colorado River	7,300 V	●		●	●	●		●	●	●		●	●	●		●	●		●	●	Heavy use-float boating
	The Maze District	3,440 V	●	●	●	●	●					●	●	●	●		●	●		●	●	Light use-poor access
	Island in the Sky District	21,780 V	●	●	●	●	●					●	●	●	●		●	●		●	●	Moderate use-but increasing
Capitol Reef National Park		469,620 V	●	●	●	●	●					●	●	●	●		●	●		●	●	Heavy use-near capacity in North District
Glen Canyon National Recreation Area	Bullfrog campground and marina	121,300 V	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●		●	●	Extreme use-spring and fall
	Hite marina and campground	73,400 V	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●		●	●	Extreme use-spring-summer-fall Exceeds carrying capacity by more than 500%
State of Utah (Div. of Parks and Recreation)																						
	Goblin Valley State Reserve	18,020 V	●	●	●	●	●	●				●	●	●	●		●	●		●	●	Light use-no developments
	Deadhorse Point State Park	129,230 V	●	●	●	●	●	●				●	●	●	●		●	●		●	●	Extreme use-near capacity
	Green River rec. area	115,980 V	●		●	●	●		●	●	●										●	Extreme use-above capacity
	Otter Creek Lake State rec. area	25,470 V	●	●	●	●			●	●	●											Heavy use-summer
Others (mixed, etc.)																						
	Koosharem Reservoir	6,000 V	●		●	●	●	●	●	●			●					●	●		●	Light-moderate use

[1]V = Visit
[2]V/D = Visitor days use (12-hour period) aggragated by one or more persons.
*Light use--generally below environmental and designed carying capacity.
Moderate use--approaching carrying capacity.
Heavy use--at carrying capacity during most of use period, but above carrying capacity on weedends and holidays.
Extreme use--usually above acceptable carrying capacity for major use facilities and environment areas visited during managed or open season.

CHAPTER IX: CONSULTATION AND COORDINATION

A. TASK FORCE ORGANIZATION

The statement is prepared by a Task Force under the leadership of the Geological Survey, Department of Interior. The other participating agencies are the Bureau of Land Management Bureau of Mines, and Fish and Wildlife Service, Department of Interior, the Forest Service, Department of Agriculture and the Interstate Commerce Commission.

The Task Force office was established in the old post office building, room 505, 350 South Main Street, Salt Lake City, Utah.

The socioeconomic impact analysis was provided under contract to the Geological Survey by the Utah Office of the State Planning Coordinator. The climate and air quality analysis was contracted to Aerovironment Inc., Pasadena, Calif., the regional cumulative historic and archeological impact assessment was done under contract by Wayne T. Van Wagoner & Associates, Inc., Salt Lake City, Utah, and the endangered and threatened plant species evaluation was contracted to Brigham Young University, Provo, Utah.

B. PUBLIC COMMENTS AND RESPONSES

A series of public information meetings were held starting May 9, 1977, by the Task Force where potential coal-mining and other coal-related activities in southern Utah were described to attendees. The purpose of the meetings was to inform the public of the proposed activities and to facilitate receipt of their concerns and comments. The public submitted their comments orally and in writing at the meeting or to the Task Force office. The public meetings in Utah were held May 9 in Kanab; on May 10 at Cedar City; on May 11 at Richfield; on May 12 at Price; and on May 18 in Salt Lake City.

Public hearings will be scheduled to obtain comments on this draft environmental statement in Kanab, Cedar City, and Salt Lake City. News releases, Federal Register notices, and special postings will announce specific hearing dates. Copies of this draft ES are available upon request until supplies are depleted.

C. CONSULTATION AND COORDINATION IN THE PREPARATION OF THE DRAFT ENVIRONMENTAL STATEMENT

During preparation of this draft environmental statement Federal, State and local agencies and representatives of private industry were consulted. Individuals with special expertise relating to the proposed actions provided information and additional data.

1. The National Park Service have contributed by providing data, reviewing draft documents and joining in field trips and office discussions. The Environmental Protection Agency have cooperated in discussions and have reviewed draft documents during this study.

2. Departments of the State of Utah have offered data, advice and consultation to Task Force members. Those providing major input to the document include; Division of Oil, Gas and Mining, Division of Water Rights, Division of Water Resources, Division of Utah Geological and Mineral Survey, Division of Parks and Recreation, Division of Wildlife Resources, and Department of Transportation.

3. The Utah State Planning Coordinator contracted the socioeconomic portion of the EIS, working with officials of local communities and associations of government.

a. Local government officials and other community leaders were involved in the impact assessment process by direct input into socioeconomic analysis and by alerting other members of the Task Force to potential beneficial or adverse impacts.

b. Mitigating measures include those desired by local and State government officials.

c. Where feasible mitigating measures were suggested for each adverse socioeconomic impact.

4. Personnel at the local area and district offices of the Bureau of Land Management in Kanab, Cedar City, Escalante, Hanksville, and Richfield participated in field reviews of the proposed actions and provided comments on early text. Similarly, District and Forest personnel from the Dixie National Forest participated in field and early text reviews.

D. COORDINATION IN THE REVIEW OF THE DRAFT ENVIRONMENTAL STATEMENT

Comments on the draft environmental statement have been requested from the following Federal, State, and local agencies. Copies were also sent to proponents, leasees, environmental, and other interest groups for their comments.

1. FEDERAL

Advisory Council on Historic Preservation
Department of Agriculture
  Soil Conservation Service
  USDA Forest Service
Department of Commerce
Department of Energy
Department of Health, Education, and Welfare

Department of Housing and Urban Development
Department of the Interior
- Bureau of Mines
- Bureau of Reclamation
- Fish and Wildlife Service
- Heritage Conservation and Recreation Service
- National Park Service
- Office of Surface Mining

Department of Labor
- Mining Safety and Health Administration
- Occupational Safety and Health Administration

Department of Transportation
Environmental Protection Agency
Federal Power Commission
Interstate Commerce Commission
National Historic Preservation Council
Office of Economic Opportunity
Office of Management and Budget
Water Resources Council

2. STATE

State of Utah A-95 Clearing House will coordinate comments from all interested State agencies.

Four Corners Regional Commission

3. LOCAL

Washington County Commission
Iron County Commission
Kane County Commission
Garfield County Commission
Emery County Commission
San Juan County Commission
Sevier County Commission
Wayne County Commission
Utah Association of Counties
Five County Association of Governments
Six County Association of Governments
Southeastern Association of Governments
Utah Association of Counties
Mayors - Utah

Alton	Henrieville	Parowan
Cannonville	Hurricane	St. George
Cedar City	Kanab	Tropic
Escalante	LaVerkin	Virgin
Glendale	Orderville	Washington

Mayors - Arizona
- Fredonia
- Page

Utah League of Cities and Towns

4. WHERE COPIES MAY BE INSPECTED

Copies of the draft environmental statements will be available for public inspection at the locations listed below. Copies may be obtained, as long as supplies last, by writing to the Denver office or picking up a copy at the Task Force office in Salt Lake City.

a. U.S. Geological Survey

U.S. Geological Survey
Preparation Branch
MS 701, Box 25046
Federal Center
Denver, Colorado 80225

Interagency Environmental Task Force on Coal
Room 505, Post Office Building
350 South Main
Salt Lake City, Utah 84101

Area Mining Supervisor's Office
8426 Federal Building
125 South State Street
Salt Lake City, Utah 84138
(801) 524-5646

Director's Office, National Center
12201 Sunrise Valley Drive
Reston, Virginia 22092
(703) 860-7411

Regional Manager's Office
7200 W. Alameda Avenue (Villa Italia)
Lakewood, Colorado 80226
(303) 234-2855

b. Bureau of Land Management

Office of the State Director
Salt Lake City, Utah 84111
(801) 277-8543

Cedar City District Office
Cedar City, Utah 84720
(801) 586-2401

Vermillion Resource Area Office
Kanab, Utah 84741
(801) 644-2672

Dixie Resource Area Office
St. George, Utah 84770
(801) 673-2463

Paria Resource Area Office
Kanab, Utah 84741
(801) 644-2672

Escalante Resource Area Office
Escalante, Utah 84726
(801) 826-4291

Richfield District Office
Richfield, Utah 84701
(801) 896-5401

Henry Mountain Resource Area Office
Hanksville, Utah 84734

Denver Service Center Library
Bldg. 50, Denver Federal Center
Denver, Colorado 80225
(303) 234-4578

c. USDA Forest Service

Supervisor's Office
Dixie National Forest
Cedar City, Utah 84720
(801) 586-2421

Escalante Ranger District
Escalante, Utah 84726
(801) 826-4312

Powell Ranger District
Panquitch, Utah 84759
(801) 676-8815

d. Libraries

Utah State University Library
University of Utah Library
Brigham Young University Library
Weber State College Library
Southern Utah State College Library
Dixie College Library
College of Eastern Utah Library
Cedar City Public Library
Iron County Bookmobile
Hurricane City Library

Kanab City Library
Garfield County Bookmobile
Parowan Public Library
Sevier County Bookmobile
Page Public Library
Price Public Library
Northern Arizona University Library
Salt Lake City Public Library
Salt Lake County Public Library

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CHAPTER XI: GLOSSARY

AIR

Air mass.--A widespread body of air that is approximately homogenous in its horizontal and vertical extent, particularly with reference to temperatue and moisture distribution.

Air pollution.--The presence of material in the air in sufficient amounts and under such circumstances as to interfere significantly with the comfort, health, or welfare of persons, or with full use and enjoyment of property.

Ambient air quality.--Concentration levels in ambient air for a specified pollutant and a specified averaging time period within a given geographic region.

Ambient air quality standard.-- A level of ambient air quality established by Federal or State agencies which is to be achieved and maintained; primary standards are those judged necessary, with an adequate margin of safety, to protect the public health; secondary standards are those judged necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant.

Ambient air pollution isomap.--A graphic portrayal of the ambient burdens of a specific pollutant throughout various areas of a mapped region. Isolines are like the contour lines on a topographic map, but instead of indicating altitude, they indicate the ambient concentrations of a pollutant in the mapped land area to which they relate.

Atmosphere.--The earth's envelope of air containing several subdivisions all bound to the earth by gravitational attraction.

Atmospheric dispersion models.--A mathematical description of the meteorological trend, transport, and dispersion processes of an area on which are superimposed rates of emissions of pollutants from various sources from which one can obtain the concentration of any pollutant at any point in the area under consideration at any time.

Atmospheric dispersion potential.--The ability of the atmosphere over any defined area to diffuse or disperse air pollutants which are introduced into the atmosphere within the defined area from point line or area emission sources.

Atmospheric stability.--The diffusive capacity of the lower atmosphere. In general, stability may be classified as either stable, neutral, or unstable. With stable conditions, the temperature increases with height the intensity of turbulence is low because vertical motions are inhibited. Under these conditons, any pollutant emitted at the ground tends to accumulate, while effluents from elevated sources do not normally reach the ground until many kilometers downwind. Conversely, when temperature decreases rapidly with height, the atmosphere is unstable, and the intensity of turbulence is high causing enhanced vertical motion. Low-level emissions are dispersed rapidly upward while high-level emissions are brought rapidly to the ground. As a result, elevated sources frequently make their maximum contributions to very short-term (less than one hour) ambient pollutant concentrations with unstable conditions. Between the stable and unstable conditions is the situation in which the temperature decreases adiabatically with height (about 1^{o}C per 100 meters). This condition is called neutral stability with near-neutral conditons quite frequent in most locations. For sources with tall stacks the high wind speed neutral conditions supresses plume rise, and is often the case in which the highest ground-level concentrations are observed. For ground-level emissions, the concentrations for near-neutral conditions normally are between those for stable and unstable conditions.

Background level.--In air pollution studies, the concentration of a pollutant that would exist in the absence of the particular source under study; a "standard" against which the contribution of the particular source can be compared.

Clean air act (42 USC 1857 et seq.).--An act for air pollution prevention and control with the purpose of: (1) To protect and enhance public health and welfare and the productive capacity of its population. (2) To initiate and accelerate a national research and development program to achieve the prevention and control of air pollution. (3) To provide technical and financial assistance to State and local governments in connection with the development and execution of their air pollution prevention and control programs. (4) To encourage and assist the development and operation of regional air pollution control programs.

Climate.--The average condition of the weather at a place over a period of years as exhibited by temperature, wind velocity, and precipitation.

Climatology.--The study of the statistical collection of weather conditions during a specified interval time (usually several decades) at a specified area. The study of the long-term manifestations of weather..

Dispersion.--The physical process of diluting the concentration of a substance by molecular and turbulent motion; e.g., smoke in air.

Diurnal.--Showing a periodic alteration of condition with day and night.

Dry adiabatic lapse rate.--Decrease in temperatue with height at a rate of 1^{o}C per 100 meters.

Dust.--Solid materials suspended in the atmosphere in the form of small irregular particles, many of which are microscopic in size. It imparts a tannish or greyish hue to distant objects. The sun's disk is pale or colorless or has a yellowish tinge at all periods of the day.

Dust cannot be a stable component of the atmosphere because it must eventually fall back to the earth's surface when winds and turbulence become too weak to bear it aloft. Dust is due to many natural and artificial sources, volcanic eruptions, salt spray from the seas, blowing solid particles, plant pollen and bacteria, smoke and ashes of forest fires and industrial combustion processes, etc.

Emission.--The act of discharging into the atmosphere an air contaminant or an effluent which contains an air contaminant, or the effluent so discharged into the atmosphere.

Emission inventory.--A quantitative statement of the types and quantities of air pollutants emitted for specified source categories within a specified place or region over a specified period of time. For any pollutant, emissions usually are expressed in terms of the tons per day emitted from specific source categories.

Emission rate.--The amount of an air pollutant emitted into the atmosphere from a pollution source over a defined period of time.

Emission standards.--Legally defined and enforced prescriptions which prohibit the emission of more than a specified quantity of a pollutant from a specifically designated source of sources, which prohibit the operation of a source or the use of a type of fuel or product, or which require the use of a type of equipment, fuel, or air pollution control system.

Free atmosphere.--(Sometime called free air). That portion of the earth's atmosphere, above the planetary boundary layer, in which the earth's surface friction on the air motion is negligible, and in which the air is usually treated (dynamically) as an ideal fluid. The base of the free stmosphere is usually taken as the geostrophic wind level.

Fugitive dust.--The solid, airborne particulate matter emitted from any source other than through a stack.

Haze.--Fine dust or salt particles dispersed through a portion of the atmosphere. The particles are so small that they cannot be felt or individually seen with the naked eye, but they diminish horizontal visibility and give the atmosphere a characteristic opalescent appearance that subdues all colors.

Implementation plan.--A document which describes a comprehensive plan of action for achieving specified air quality objectives and standards for a particular place or region within a specified time period.

Inversion.--(Also temperature inversion.) A departure from the usual decrease in temperature with altitude. An inversion layer refers to the layer through which this increase in potential temperature with height occurs.

Inversion base.--The level in which the increase in potential temperature begins.

Inversion layer.--A layer in the atmosphere through which the temperature remains constant or increases with altitude.

Isopleth.--A line or contour drawn on a map denoting points having the same numerical value of an element; e.g., similar temperature (isotherm), pressure (isobar), or pollutant concentrations.

Isothermal.--No temperature change with height.

Lapse rate.--The change of temperature with height. A "lapse" condition usually means a decrease with height.

Limited mixing conditions.--A type of fumigation which may occur with light winds when an effluent is released and contained within a limited mixing volume beneath an inversion layer. Under these conditons, a plume will usually rise to the top of the surface based mixing layer and then undergo vetical mixing to the surface.

Looping plume.--Effluent plume being rapidly spread upward and downward by thermally induced eddies. Occurs in a highly unstable atmosphere because of rapid mixing.

Meteorlogical factors or elements.--Types of measurements necessary for the consideration of air pollution problems. Generally, these are pressure, temperature, and humidity of the atmosphere; speed and direction of the wind; and in some cases the amount of insolation (sun intensity).

Meteorology.--A science that deals with the atmosphere and its phenomena, especially with weather and weather forecasting.

Micro-scale.--In meteorology, having characteristic spatial dimensions of about 1 mile and less. Typical micro-scale phenomena include the retention of moisture by crops, etc.

Mixing depth.--Height of the layer of air where well-mixed conditions exist, usually the height of the first significant inversion above the surface.

National ambient air quality standards (NAAOS).--The allowable concentrations of air pollutants in the ambient air specified by the Federal Government and can be found in Title 40, Code of Federal Regulations, Part 50. The ambient air quality standards are divided into primary standards (based on the air quality criteria and allowing an adequate margin of safety, are requisite to protect the public health) and secondary standards (based on the air quality criteria and allowing an adequate margin of safety, are requisite to protect the public welfare from any known or anticipated adverse effects associated with the presence of air pollutants in the ambient air. Welfare is defined as including but not limited to, effects on soils, water, crops, vegetation, manmade materials, animals, wildlife, weather, visibility, and climate, damage to and deterioration of property, and hazards to transportation, as well as effects on economic values and on personal comfort and well-being.

National emission standards for hazardous air pollutants.--Standards of performance for certain identified pollution emission sources for pollutants of asbestos, beryllium, and mercury. The standards are found in Title 40, Code of Federal Regulations, Part 61.

Nephelometer.--General name for instruments which measure, at more than one angle, the scattering function of particles suspended in a medium.

Neutral atmosphere.--An atmospheric condition in which the air cools, as altitude increases at the normal, dry adiabatic temperature lapse rate: $0.98^{\circ}C$ for every 100 meters.

Opacity.--The degree to which emissions reduce the transmission of light and obscure the view of an object in the background. A state which renders material partially or wholly impervious to rays of light and causes obstruction of an observer's view.

Oxidant.--A gas that oxidizes: usually ozone.

Particulate matter.--Any material, except water in a chemically uncombined form, that is or has been airborne and exists as a liquid or a solid at standard temperature and pressure conditions. Minute particles of coal dust, fly ash, and oxides temporarily suspended in the atmosphere.

Photochemical.--Referring to chemical reactions that require light.

Photometry.--A physical method of measurement based on the transmission of light.

Pilot balloon.--A small balloon with known ascent rate whose track is followed by a theodolite (optical tracking instrument similar to a surveyor's transit). In order to obtain data for the computation of speed and direction of winds in the upper air.

Plume.--The volume of air space containing any of the substance emitted from a point source. For practical purposes, the limits of a plume have to be arbitrarily defined according to some minimum concentrations of the substance.

Plume rise.--The height attained by a plume from vertical momentum and bouyancy due to heat and molecular-weight difference of material released into the atmosphere. The behavior of this plume, the material contained in a volume of gas, will be influenced by chimney phenomena, surrounding buildings, terrain, as well as the velocity and buoyancy relative to the air and prevailing meteorological conditons.

Concentration.--A measure of the average density of pollutants usually specified in terms of pollutant mass per unit volume of air (typically in units of micrograms per cubic meter), or in terms of relative volume of pollutants per unit volume of air (typically in units of parts per million.).

Pollution source.--A point, line, area, or volume at which pollution is added to a system, either instantaneously or continuously. Conversely, at a "sink" mass pollution is removed.
Examples of sources in the context of air pollution are as follows: a smokestack is a "point source," a freeway or aircraft trajectory is a "line source;" and an entire city is a "plane source."

Precipitation.--Any of all the forms of water particles, whether liquid or solid, that fall from the atmosphere and reach the ground. Precipitation includes drizzle, rain, snow, snow pellets, snow grains, ice crystals, ice pellets, and hail.

Prevailing wind--The wind direction most frequently observed during a given period.

Rawinsonde.--Method of upper-air observation consisting of a computation of wind speed and direction, temperature, pressure and relative humidity by means of a balloon-borne radiosonde tracked by radar.

Relative humidity.--Generally, the relative measure of water vapor content in the atmosphere; precisely, the dimensionless ratio of the actual vapor pressure of the air to the saturation vapor pressure (usually given in percent).

Stability.--See Static stability.

Stability wind rose.--Average atmospheric conditons based on short- or long-term meteorological data set of joint fequency, wind direction, wind speed, and atmospheric stability.

Stable.--Pertaining to the atmosphere or an atmospheric layer in the condition of static stability, i.e., an atmosphere whose temperature lapse rate and moisture distribution is such as to suppress the vertical exchange of air.

Stagnation.--With respect to air pollution, the persistence of a given volume of stable air over a region, permitting an abnormal buildup of pollutants from sources within the region.

Static stability.--(Also called hydrostatic stability, vertical stability, convective or convectional stability.) The state of the atmosphere when it is stable relative to vertical displacements. Such an atmosphere tends to remain stratified, in that any air that is displaced vertically is subjected to a buoyant force that tends to restore it to its original level.

Static stability is determined primarily by the temperature lapse rate; an inversion layer is an extreme example of statically stable layer.

State implementation plan.--A document which describes a comprehensive plan of action for achieving specified air quality objectives and standards for a particular place or region within a specified time period.

Standards of Performance for New Stationary Sources (NSPS).--Standards of performance which set limitations on the pollution emissions of defined pollutants from specific pollution sources. The standards are found in Title 40, Code of Federal Regulations, Part 60.

Subsidence inversion.--Air inversion aloft caused by sinking air within a high pressure system which causes the temperature at the top of the layer to increase more than the temperature at the bottom of the layer. The effect is the creation of a limited mixing volume below the stable layer.

Surface winds.Winds close to the earth's surface which are influenced in direction and speed by frictional interaction with the terrain.

Synoptic pressure pattern.--Pattern of isopleths (see glossary definition) of constant pressure over a horizontal surface (usually mean sea level) at a given time. Can also mean isopleths of height of a given pressure at a given time.

Turbidity.--A measure along the line of sight of the attenuation of solar radiation in a clear sky due to atmospheric suspensoids.

Unstable atmosphere.--A conditon characterized by a temperature decrease with height greater than the standard adiabatic lapse rate of $1^{o}C$ per 100 meters. Marked vertical mixing occurs and pollutants are rapidly dispersed.

Upper winds.--Winds at sufficient altitude above the earth's surface, such as to be minimally influenced in direction and speed by terrain features.

Variance (as applies to air quality).--An order issued pursuant to law which extends to some person or persons the legal right to operate a specific air pollution source or sources in violation of air pollution laws, regulations, and emissions standards. Usually variances are authorized in order to give the owner or operator of a source sufficient time to comply with an emission standard.

Visibility.--The greatest distance in a given direction of which it is possible to see and identify with the unaided eye a prominent dark object against the sky at the horizon.

Weather.--The state of the atmosphere with respect to heat or cold wetness or dryness, calm or storm; clearness or cloudiness.

Wind rose.--Any one of a class of diagrams designed to show the distribution of wind direction experienced at a given location over a specified period. The most common form consists of a circle from which sixteen lines emanate, one for each compass point. The length of the line is proportional to the frequency of the wind from that direction.

GEOLOGY

Anticline.--Term applied to rock strata which dip in opposite directions from a common ridge or axis, like the roof of a house.

Bentonite.--A clay mineral formed from decomposition of volcanic ash. Commonly has great ability to absorb or adsorb water and swell accordingly.

Dip.--The angle at which a stratum or any other planar feature is inclined from the horizontal.

Fold axis.--The line following the apex of an anticline or the lowest part of a syncline.

Monocline.--A steplike bend in otherwise horizontal or gently dipping beds.

Richter magnitude.--A quantity characteristic of the total energy released by an earthquake, as contrasted to "intensity" which describes its effects at a particular place.

Seismic.--Pertaining to, characteristic of, or produced by earthquakes or earth vibration.

Stratigraphy.--The branch of geology which treats of the formation, composition, sequence, and correlation of the stratified rocks as parts of the earth's crust.

Strike.--The bearing of the outcrop of an inclined bed on a level surface; it is perpindicular to the direction of the dip.

Structural basin.--An elliptical or roughly circular structure in which the rock strata are inclined toward a central point.

Syncline.--A fold in rocks in which the strata dip inward from both sides. The opposite of anticline.

Type locality.--The place at which the type specimen of a species was collected.

Type section.--A a stratigraphic section recognized as the standard; generally the one from which a stratigraphic unit received its name.

SOILS

Alkaline soil.--Precisely, any soil horizon having a pH value greater than 7.0; practically, a soil having a pH above 7.3.

Alluvial fan.--A sloping, fan-shaped mass of sediment deposited by a stream where it emerges from upland onto a plain.

Alluvial soils.--Soils developed from transported and relatively recently deposited material (alluvium) characterized by a weak modification (or none) of the original material by soil forming processes.

Alluvial valley floors.--"Unconsolidated stream-laid deposits holding streams where water availability is sufficient for subirrigation or flood irrigation agricultural activities but does not include upland areas which are generally overlain by a thin veneer of colluvial deposits from sheet erosion, deposits by unconcentrated runoff or movement accumulation and windblown deposits"; (as defined in the Federal Register, vol. 42, no. 230, Dec. 13, 1977).

Alluvium.--Clay, silt, sand, and gravel or other rock material transported by flowing water and deposited as sorted or semi-sorted sediments.

Available water-holding capacity (soils).--The capacity to store water available for use by plants, usually expressed in linear depths of water per unit depth of soil.

Calcareous soil.--A soil that contains enough calcium carbonate (often with magnesium carbonate) to effervesce (fizz) visibily when treated with cold, dilute hydrocloric acid.

Slightly calcareous.--1 to 3 percent lime.
Moderately calcareous.--3 to 15 percent lime.
Strongly calcareous.--15 to 40 percent lime.
Very strongly calcareous.--More than 40 percent lime.

Carbonate.--A mineral compound characterized by a fundamental anionic structure of $CO_3^{\pm}$. Calcite and aragonite, $CaCO_3$, are examples of carbonates.

Clay.--As a soil separate, the mineral soil particles are less than 0.002 millimeters in diameter. As a soil textural class, the soil material is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Coarse fragments.--The gravel, cobblestones, or stones in a soil that range in size from 2 millimeters to 3 feet.

Cobbles.--Rounded mineral or rock fragments that range from 3 to 10 inches in diameter.

Colluvial, colluvium.--Loose and incoherent deposits consisting of alluvium and angular fragments of rocks usually at the foot of a slope or cliff and brought there by gravity.

Depth, soil.--The terms and their meanings used to describe depth of the soil over bedrock or over a restricting lay are:

Deep.--More than 36 inches.
Moderately deep.--20 to 36 inches.
Shallow.--10 to 20 inches.
Very shallow.--Less than 10 inches.

Disturbance, soil .--The act of altering natural soil characteristics, usually by mechanical means. This includes soil exposure (removal of the organic layer and vegetation), mixing of soil materials, compaction, and soil displacement (moving from one place to another).

Drainage, soil.--The relative rapidity and extent of the removal of water from on and within the soil under natural conditons. Terms commonly used to describe drainage are:

Excessively drained.--Water is removed from the soil rapidly. The soils are typically sandy and porous.

Well drained.--Water is removed from the soil readily but not too rapidly. There is no evidence of wetness above a depth of 40 inches.

Moderately well drained.--Water is removed from the soil somewhat slowly so that the soil is wet for short but significant, periods of time.

Somewhat poorly drained.--Water is removed from the soil slowly enough to keep it wet for significant periods but not all the time. Wetness is apparent between a depth of 20 and 40 inches.

Poorly drained.--Water is removed from the soil so slowly that the water table is near the surface most of the time. Wetness is apparent within 20 inches of the surface.

Very poorly drained.--Water is removed from the soil so slowly that the water table is at or on the surface most of the time. These soils are generally in low areas or depressions. Erosion-The wearing away of the land surface by wind, running water, gravity and other geological agents.

Erosion pavement.--The small surface gravel which is left on the land after the soil is eroded away.

Gypsum soils.--Soils which contain high amounts of hydrated calcium sulfate ($CaSO_4$, $2H_2O$), occuring in crystals and in masses. Calcuim sulfate is water soluble and will dissolve out of the soil profile when exposed to high amounts of water, which in turn creates a piping affect (a downward or lateral movement of water through the soil).

Hardpan.--A hardened or cemented soil horizon, or layer. The soil material may be gravelly, sandy or clayey, and it may be cemented by iron oxide, silica, calcium carbonate, or other substances. Horizon, soil.--A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes. The following are major horizons:

O horizon.--The layer of organic matter on the surface of a mineral soil, consisting of decaying plant residues.

A horizon.--The mineral horizon at the surface or just below an O horizon. This horizon is the one in which living organisms are most active and therefore is marked by the accumulation of humus.

The horizon may have lost one or more soluble salts, clay and sesquioxides (iron and aluminum oxides).

B horizon.--The mineral horizon just below an A horizon. The B horizon is in part a layer of change from the overlaying A to the underlying C horizon. The B horizon also has distinctive characteristics caused by 1) by accumulation of clay, sesquioxides, humus, or some combination of these; 2) by prismatic or blocky structure: 3) by redder or stronger colors than the A horizon; or 4) by some combination of these. Combined A and B horizons are usually called the solum.

C horizon.--The weathered rock material immediately beneath the solum. In most soils, this material is presumed to be like that from which the overlying horizons were formed.

Hydrologic Soil Groups.--The hydrologic soil groups are used to estimate runoff from rainfall. Soil properties which are considered are those that influence the rate of infiltration obtained from a bare soil after prolonged wetting. Soil properties considered are: 1) depth of seasonally high water table, 2) intake rate and permeability after prolonged wetting, 3) depth to very slowly permeable layer. The soils have been classified into four groups, A through D. Group A soils have low runoff potential; group B soils have moderately low runoff potential; group C soils have moderately high runoff potential; and group D soils have high runoff potential.

Parent material.--Unconsolidated and partially weathered geologic material from which soils are presumed to form.

Permeability, soil.--That quality of the soil that enables it to transmit water or air. Terms used to describe permeability in inches per hour are:

Very slow.--Less than 0.06 inches.
Slow.--0.6 to 0.2 inches.
Moderately slow.--0.2 to 0.6 inches.
Moderate.--0.6 to 2.0 inches.
Moderately rapid.--2.0 to 6.0 inches.
Rapid.--6.0 to 2.0 inches.
Very rapid.--More than 20 inches.

pH.--A number that represents the negative logarithm, base 10, of the hydrogen-ion activity of a solution. A pH less than 7 indicates an acid solution; a pH greater than 7, an alkaline solution.

Prime farmland.--Those lands as defined in the Federal Register on Aug. 23, 1977, that have been used for the production of cultivated crops, including nurseries, orchards, and other specialty crops, and small grains for at least 5 years out of the 20 years preceding the date of the mining permit application. A detailed definition is also given in the Federal Register, Dec. 13, 1977.

Profile, soil.--A vertical section of the soil through all its's horizons and extending into the parent material.

Reaction, soil.--The degree of acidity or alkalinity of a soil expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. An acid, or "sour" soil is one that gives an acid reaction; an alkaline soil is one that is alkaline in reaction. The degrees of acidity or alkalinity are expressed in the following words:

Extremely acid.--Below 4.5.
Very strongly acid.--4.5 to 5.0.
Strongly acid.--5.1 to 5.5.
Medium acid.--5.6 to 6.0.
Slightly acid.--6.1 to 6.5.
Neutral.--6.6 to 7.3.
Mildly alkaline.--7.4 to 7.8.
Moderately alkaline.--7.9 to 8.4.

Strongly alkaline.--8.5 to 9.0.
Very strongly alkaline.--9.1 and higher.

Reclamation.--The process of returning disturbed lands to their former uses or other productive uses.

Residual soil.--A soil formed in material weathered from bedrock without transportation from the original location.

Rockiness.--A description of rock expressed as a volume percentage of the surface. General classifications are:
Class 0.--Less than 2 percent.
Class I.--2 to 10 percent (rocky).
Class II.--10 to 25 percent (very rocky).
Class III.--25 to 50 percent (extremely rocky).
Class IV.--50 to 90 percent (rockland).
Class V.--Over 90 percent (rock outcrop).

Sand.--As a soil separate, the individual rock or mineral fragments in soils have diameters ranging from 0.05 to 2.0 millimeters. Most sand grains consist of quartz, but they may be any mineral composition. As a soil textural class, soil material that is 85 percent or more sand and not more than 10 percent clay.

Saline soil.--A soil that contains soluble salts in amounts that impair growth of plants but that does not contain excess exchangeable sodium.

Sediment yield.--The amount of soil an area loses every year through natural processes, usually expressed in acre-feet per square mile per year. One acre-foot per square mile per year, reduced to simpler terms, means that a square mile of land loses about .01 inches of soil every year. This is a result of the normal and ongoing processes of water and wind erosion.

Sheet erosion.--The removal of a fairly uniform layer of soil from the land surface by runoff water.

Shrink-swell.--Describes that soil quality that determines its volume change with change in moisture content.

Silt.--As a soil separate, the individual mineral particles in a soil that ranges in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil material that is 80 percent or more silt and less than 12 percent clay.

Soil.--A natural, three-dimensional body on the earth's surface that supports plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil productivity.--The capacity of a soil in its normal environment for producing a specified plant or sequence of plants under a specified system of management.

Soil structure.--The combination or arrangement of primary soil particles (sand, silt, clay) into secondary particles, units, or peds. The secondary units or soil aggregates are characterized and classified on the basis of size, shape, and degree of distinctness into classes, types, and grades, respectively.

Soil texture.--The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are sand, loamy sand, sandy loam,

loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay, and clay. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse, fine, or very fine".

Solum.--This refers to the combined A and B horizons. Stones--Rock fragments greater than 10 inches in diameter, if rounded, and greater than 15 inches along the longer axis, if flat.

Subsoil.--Describes the B horizon of the soil profile, roughly the part of the solum below plow depth or below the dark colored A horizon.

Surface layer.--A term used in nontechnical soil descriptions for one or more layers above the subsoil. Includes A horizon and part of B horizon and has no depth limit.

Talus.--An accumulation of rock debris, formed close to a mountain wall, mainly through many small rockfalls.

Terrace.--1) An embankment or combination of an embankment and channel constructed across a slope to control erosion by diverting or storing surface runoff instead of permitting it to flow uninterrupted down the slope. 2) A level, usually narrow plain bordering a river, lake, or sea. Rivers sometimes are bordered by terraces at different levels. Topsoil.--The original or present dark-colored upper soil (A horizon) that ranges from a mere fraction of an inch to 2 or 3 feet thick on different kinds of soil.

WATER

Aquifer.--A formation, group of formations, or part of a formation that contains sufficient saturated permeable material to yield significant quantities of water to wells and springs.

Arestian (confined) aquifer.--A water-yielding zone in which ground water is confined under pressure by impervious or semipervious strata.

Perched ground water.--Unconfined ground water separated from an under lying body of ground water by an unsaturated zone.

Head, static.--The height of a column of water above a standard datum that can be supported by the static pressure at a given point.

Water table.--That surface in an unconfined water body at which the pressure is atmospheric.

Acre-foot.--The quantity of water required to cover 1 acre to a depth of 1 foot; equal to 43,560 cubic feet for 325,851 gallons.

Base flow.--Sustained or fair weather runoff. In most streams, base flow is composed largely of ground-water effluent.

Bank storage.--The water absorbed into the banks of a stream channel when the water level rises above the water table in the bank form ations.

Ephemeral stream.--A stream that flows only in direct response to precipitation, and whose channel is at all times above the water table.

Intermittent stream.--A stream that flows only at certain times of the year when it receives water from springs or from some surface source such as melting snow in mountainous areas.

Usable storage.--The volume of water normal available for release from a reservoir below the stage of the maximum controllable level

100-year 6-hour precipitation.--The precipitation of 6-hour duration that will be equalled or exceeded once overy 100 years on the average.

RANGE AND VEGETATION

Animal unit month.--The volume of forage consumed by one cow or five sheep in one month. A measure of range carrying capacity.

Carrying capacity.--(Range) The maximum use of the range possible without inducing damage to vegetation or related resources. (Syn., grazing capacity)

Grazing capacity.--Syn., carrying capacity.

Vegetation type.--A plant community with observable features.

WILDLIFE

Browse.--Tender shoots or twigs of shrubs and trees as food for deer, cattle, etc.

Coniferous.--Belonging or pertaining to cone-bearing evergreen trees or shrubs.

Exotic species.--Introduced species. Not native to a given area.

Eyrie.--The nest of a bird of prey.

Hunter-day.--Time spent hunting by one hunter. It may include all or part of one day.

Life zone.--An area characterized by a particular set of organisms, whose presence is determined by environmental conditions.

Omnivores.--An animal or bird that eats all kinds of foods indiscriminately.

Raptor.--Living on prey; a group of carnivorous birds consisting of the hawks, eagles, falcons, vultures, and owls.

Reparian.--Living on or adjacent to a water supply such as a riverbank, lake, or pond.

RECREATION

Backcountry.--An area of land used for hiking, backpacking, undeveloped area camping, solitude, fishing and hunting. Generally located some distance from developed roads and the sights and sounds of users can enjoy an unconfined, uncrowded and generally unregulated recreation experience.

Carrying capacity.--The number of people, expressed in PAOT that an area or facility can accomodate without impairment of the natural, cultural or developed resource.

Developed site.--designated area with picnic tables, grills, garbage collection, sanitary facilities, parking and play areas developed primarily by families, organized groups or individuals for overnight camping or day-use activities.

Dispersed area.--General environment areas, including recreation woods, trails, lakes, ponds, streams and general undeveloped areas suitable and used for recreation, and not codified as development sites.

Recreation experience level (5).--

a) Primitive.--Uncrowded, void of developments, where the user feels as though he is a part of nature and his presence and survival is dependent on his own skills and ability.

b) Semi-primitive.--Similiar to primitive, but the user has the feeling that civilization is not far away. Generally located some distance from civilization, but user may have reached destination by motorized carrier and some development and evidence of previous use may be present in area. Solitude and a sense of personal achievement is necessary.

c) Intermediate.--Usually adjacent to developed roads or facilities other people present and some developed facilities and roads exist in the proximity of the area being used.

d) Secondary-modern.--Developed facilities, such as picnic tables, grills, open-vault toilets are present, area is usually occupied by others, evidence of mans activities, developments, etc. are present and substantially noticeable.

e) Modern.--Developed facilities are modern: i.e. flush toilets, trailer hook-ups, hard-surfaced roads, developed play areas, etc. User experience level is definitely associated with use by other individuals and is usually restricted or regulated to a high degree (i.e. travel and camping is restricted to developed and surfaced sites and fees for use are usually charged to the user).

Extreme use.--Of the greatest severity; drastic, excessive.

Heavy use.--Intense or sustained, large in numbers.

Moderate use.--Not excessive or extreme, of medium or average quantity or extent.

Light use.--Of relatively low density, generally non-impactive, insignificant.

NRA.--National Recreation Area - a designated or classified area of land (and water) dedicated for recreation use by the public.

ORV.--Off-road vehicle, including four wheel drive, trail bikes, hovercraft, snowmobiles, etc., but excluding helicopters, fixed wing aircraft and boats, and capable of travelling over land, water, ice, snow, sand, marshes, etc.

PAOT.--People at One Time - used to quantify the number of people an area can accomodate at any one time without deterioration to the natural, cultural or developed character of a given area - see carrying capacity.

Primitive area.--A formally or informally classified area set aside for its wild, undeveloped character, used and maintained for its natural values for nature studies, wildlife, sight-seeing, watershed and recreation. Few if any man-made intrusions exist and man is only a temporary visitor who does not remain.

Rare I - Rare II.--Roadless area resource evaluation system - used to identify and inventory area without developed roads and substantial intrusion by man for inclusion or exclusion in the Wilderness Preservation System. Rare II is an intensified and expanded inventory and evaluation of the Rare I process.

Roadless area.--Without formally designated or developed and maintained roads, or substantial developments and man-made intrusions.

Significant impact.--Important, of consequence, of or pertaining to a major change or impact to an existing situation.

Visit.--The entry of any person upon a site, or area of land or water for recreation purposes. No time element involved; may be for a few minutes or a number of days. Term is usually used to report recreation use by National Park Service, Bureau of Land Management and Utah State Division of Parks and Recreation.

V/D's - Visitor Days Use.--12 visitor-hours which may be aggregated continously, intermittently, or simultaneously by one or more persons for recreation purposes. Term is used primarily by U. S. Forest Service for determining use of recreation areas and resources.

Wilderness area.--A formally classified area under the Wilderness act of 1964, where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain. Undeveloped Federal land retaining its primeval character; has outstanding opportunities for solitude or a primitive and unconfined type of recreation and may contain ecological, geological or other features of scientific, educational, scenic or historical value(s).

ARCHEOLOGY AND HISTORY

Artifact.--A single, portable man-made or man-altered object: usually culturally diagnostic.

Ceremonial Site.--A site exhibiting multiple dwelling structures of religious function characterized by religious art and (or) kivas.

Cist.--Storage pit in the ground usually lined with rock slabs.

Cultural resources.--Physical remains of human activity over 100 years old.

Extended camp.--A non-architectural site of varying size, exhibiting hearth or fire pits; ceramics: lithic and grinding tools, especially non-transportable metates.

Historic Site.--A site exhibiting artifacts that postdate the first Mormon settlements in Utah in 1847.

Hunting site.--A location characterized by projectile points or point fragments only.

Kill-butchering site.--A location with points or point fragments and knives, choppers and (or) scrapers.
A location characterized by the predominance of butchering tools, including knives, choppers, utilized flakes, and (or) scrapers.

Lithic scatter site.--Characterized by the presence of flaked tools, chips, cores, or flakes only.

Multiple habitation.--Multiple structures that would accomodate more than one family.

Petroglyph.--Figures, symbols, or scenes pecked or etched in rock.

Pictograph.--Figures, symbols, or scenes painted on rock.

Quarry site.--A lithic mine showing presence of hammerstones, flakes, cores, and unfinished tools.

Rock shelter.--A small or large rock overhang used as a protective dwelling; characterized by the presence of artifacts and smoke-blackened rock overhand.

Single habitation.--Small structure such as a pithouse that would accomodate a single family.

Site.--Locus of human activity identified by a minimum of four flakes within a five-meter radius, from documents, or by archeological techniques.

Temporary camp.--A small site exhibiting no architecture; characterized by a hearth or fire pit, lithic and small grinding tools, and ceramics.

ESTHETICS

Two visual resource inventory and evaluation systems are used for lands involved, Bureau of Land Management system for public lands and the National Forest landscape management system on National Forest lands. National Park Service lands fall within the special classified area designation (see definition above.) Where Bureau of Land Management and Forest Service terms have similar meaning, only one defin-ition is provided. Where a term applies only to public lands, it is footnoted with a 1/. System terms applicable only to National Forest lands are footnoted with a 2/. Additional information concerning the Bureau of Land Management visual resource system may be obtained by writing to: Office of the State Director, Bureau of Land Management, University Club Building, 136 East South Temple, Salt Lake City, Utah 84111, for National Forest information, write to: Regional Forester, Federal Office Bldg, 324-25th Street, Ogden, Utah 84401.

Adverse visual impact.--Any impact on the vegetation, landform, or any introduction of a structure or activity which interrupts or adversely changes the visual character of the landscape and disrupts the harmony of the natural elements.

Background.--The distant part of a landscape, picture, etc.; surroundings, especially those behind something and providing harmony or contrast; surrounding area or surface. Area located from 3-5 miles to infinity from the viewer.

Background.--The area of a visual zone which lies beyond the foreground-middleground. Usually from a minimum of 3-5 miles to a maximum of about 15 miles from a travel route or use area. Atmospheric conditions in some areas may limit the maximum to about 8 miles or increase it beyond 15 miles.

Basic elements.--The four major elements (form, line, color, and texture) which determine how the character of a landscape is perceived.

Characteristic.--That which constitutes a character; that which characterizes; a distinguishing trait, feature, or quality; a peculiarity.

Characteristic landscape.--The established landscape within an area being viewed. This does not necessarily mean a naturalistic character. It could refer to a farming community, an urban landscape, or a primarily natural environment.

Character type.--Large physiographic area of land which has common characteristics of landforms, rock formations, water forms, and vegetative patterns.

Character subtype.--A division of a major character type which is significantly different in visual characteristics from the other subtypes.

Common.--Refers to prevalent, usual, or widespread landscape variety within a character type. It also refers to ordinary or undistinguished visual variety.

Contrast.--The effect of a striking difference in the form, line, color, or texture of an area being viewed.

Distance zones.--Areas of landscapes denoted by specified distances from the observer. Used as a frame of reference in which to discuss landscape characteristics or activities of man.

Distinctive.--Refers to unusual and(or) outstanding landscape variety that stands out from the common features in the character type.

Diverse.--Refers to having variety in landscape character.

Dominance elements.--Form, line, color, and texture. They are the visual recognition parts which make up the characteristic landscape.

Dominant.--Ruling; governing; predominant; exercising great influence.

Dynamic.--Active or changing.

Enhancement.--A short-term management alternative which is done with the express purpose of increasing positive visual variety where little variety now exists.

Evident.--That which is apparent to the casual visitor.

Feature.--A visually distinct or outstanding part, quality, or characteristic of something.

Foreground.--The detailed landscape found within 0 to 1/4-1/2 mile from the observer.

Foreground-middleground.--The area visible from a travel route or use area to a distance of 3-5 miles. The outer boundary of this zone is defined as the point where the texture and form of individual plants is no longer apparent in the landscape. Vegetation is apparent only in patterns or outline.

Form.--The shape or structure of something as opposed to the material of which it is composed.

Intrusion.--A feature (land, vegetation, or structure) which is generally considered out of context with the characteristic landscape.

Landscape character.--The arrangement of a particular landscape as formed by the variety and intensity of the four basic elements of form, line, color, and texture.

Landscape modifying activities.--Any action which changes the vegetation or landform or places structures on the landscape.

Line.--a. an intersection of two planes. A point that has been extended; silhouette of form.
b. any of various things that are or may be considered as arranged in a row or sequence.

Management activity.--An activity of man imposed on a landscape for the purpose of harvesting, traversing, transporting, or replenishing natural resources.

Maximum modification.--A visual quality objective meaning man's activity may dominate the characteristic landscape but should appear as a natural occurrence when viewed as background.

Middleground.--The space between the foreground and the background in a picture or landscape. The area located from 1/4-1/2 to 3-5 miles from the viewer.

Minimal.--Refers to little or no visual variety in the landscape. Monotonous or below average compared to the common features in the character type.

Modification.--A visual quality objective meaning man's activity may dominate the characteristic landscape but must, at the same time, utilize naturally established form, line, color, and texture. It should appear as a natural occurrence when viewed in foreground or middleground.

Monotony.--Complete repetition; tedious sameness.

Naturalistic character.--A landscape situation where the basic elements are displayed in a composition that appears natural within the surrounding area or character type.

Partial retention.--A visual quality objective which in general means man's activities may be evident but must remain subordinate to the characteristic landscape.

Perception.--a. man's impression of an object or space as based on past and (or) anticipated experiences.
b. making one's self aware of all conditions and applicable factors; comprehension.

Preservation.--P. or I. areas -- a visual quality objective that provides for ecological change only. (see definitions next page.)

Rehabilitation.--A short term management alternative used to return existing visual impacts in the natural landscape to a desired visual quality.

Retention.--R. or II. areas -- a visual quality objective which in general means man's activities are not evident to the casual visitor. (see definitions next page.)

Scenic quality.--The quality of the scenery as determined through the use of the scenic evaluation process or the visual resource inventory and evaluation systems.

Seen area.--Total area observed. May be measured in terms of foreground, middleground, and background.

Seldom seen.--Areas that are seen from low-use volume transportation routes or are beyond the 15-20 mile background zone for other routes.

Sensitivity level(s).--An index of the relative importance or value of visual response to an area in relation to other areas in the planning unit, or a particular degree or measure of viewer interest in the scenic qualities of the landscape.

Special classified area.--Those areas such as Wilderness, historical, biological, or geological sites which are of such significance that specific management direction is given as part of policy or legislation.

Subordinate.--Inferior to or placed below another in size, birghtness, etc.; secondary in visual impact.

Texture.--The visual result of the tactile surface characteristic of an object or objectives.

Use volume.--The total volume of visitor use each segment of a travel route or use area receives.

Variety.--The state or quality of being veried and having the absence of monotony or sameness.

Variety class or scenic quality class.--A particular level of visual or diversity of landscape character. (Generally applicable to both Public Lands and National Forest lands. Some difference may apply.)

Visitor.--Temporary inhabitor of an area. Recreation visitor--one who is in an area temporarily for refreshment in body and(or) mind. Usually has a significant conscious or subconscious interest in the scenic qualities of an area.

Visual management unit.--An area of land where there is no variation in the visual zone, sensitivity zone, and scenic quality zone.

1/ Visual resource management classes.--The degree of alteration that is acceptable within the characteristic landscape. It is based upon the physical and sociological characteristics of any given homogeneous area.

Class I: natural ecological changes only.

Class II: changes must not be evident.

Class III: changes may be evident but must remain subordinate to natural landscape characteristics.

Class IV: changes may subordinate but should reflect natural occurrences.

Class V: rehabilitation or enhancement needed.

2/ Visual quality objective.--A desired level of excellence based on physical and sociological characteristics of an area. Refers to degree of acceptable alteration of the characteristic landscape.

P preservation	MM maximum modification
R retention	reh rehabilitation
PR partial retention	e enhancement
M modification	

Visual resource.--The land, water, vegetative, animal, and other features that are visible on all lands.

Visual zones.--The area that can be seen as foreground-middleground, background, or seldom seen. (see previous definitions.)

	CLASS A Distinctive	CLASS B Common	CLASS C Minimal
Landform	Over 60 percent slopes which are dissected, uneven, sharp exposed ridges or large dominant features.	30-60 percent slopes which are moderately dissected or rolling.	0-30 percent slopes which have little variety. No dissection and no dominant features.
Rock Forms	Features stand out on landform. Unusual or outstanding, avalanche chutes, talus slopes, outcrops, etc., in size, shape, and location.	Features obvious but do not stand out. Common but not outstanding, avalanche chutes, talus slopes, boulders and rock outcrops.	Small to nonexistent features. No avalanche chutes, talus slopes, boulders and rock outcrops.
Vegetation	High degree of patterns in vegetation. Large old-growth timber. Unusual or outstanding diversity in plant species.	Continuous vegetative cover with interspersed patterns. Mature but not outstanding old-growth. Common diversity in plant species.	Continuous vegetative cover with little or no pattern. No understory, overstory or ground cover.
Water Forms, Lakes	50 acres or larger. Those smaller than 50 acres with one or more of the following: (1) Unusual or outstanding shoreline configuration, (2) reflects major features, (3) islands, (4) Class A shoreline vegetation or rock forms.	5 to 50 acres. Some shoreline irregularity. Minor reflections only. Class B shoreline vegetation.	Less than 5 acres. No irregularity or reflection.
Water Forms, Streams	Drainage with numerous or unusual changing flow characteristics, falls, rapids, pools and meanders or large volume.	Drainage, with common meandering and flow characteristics.	Intermittent streams or small perennial streams with little or no fluctuation in flow or falls, rapids, or meandering.

This chart represents a variety or scenic quality class breakdown of steep mountain slopes. This chart is appropriate for this character type only. A similar chart must be developed for other character types according to the characteristics of the land, i.e., desert lands, transitional lands, etc. Water, for instance, in almost any form on desert lands will elevate the variety or scenic quality class.

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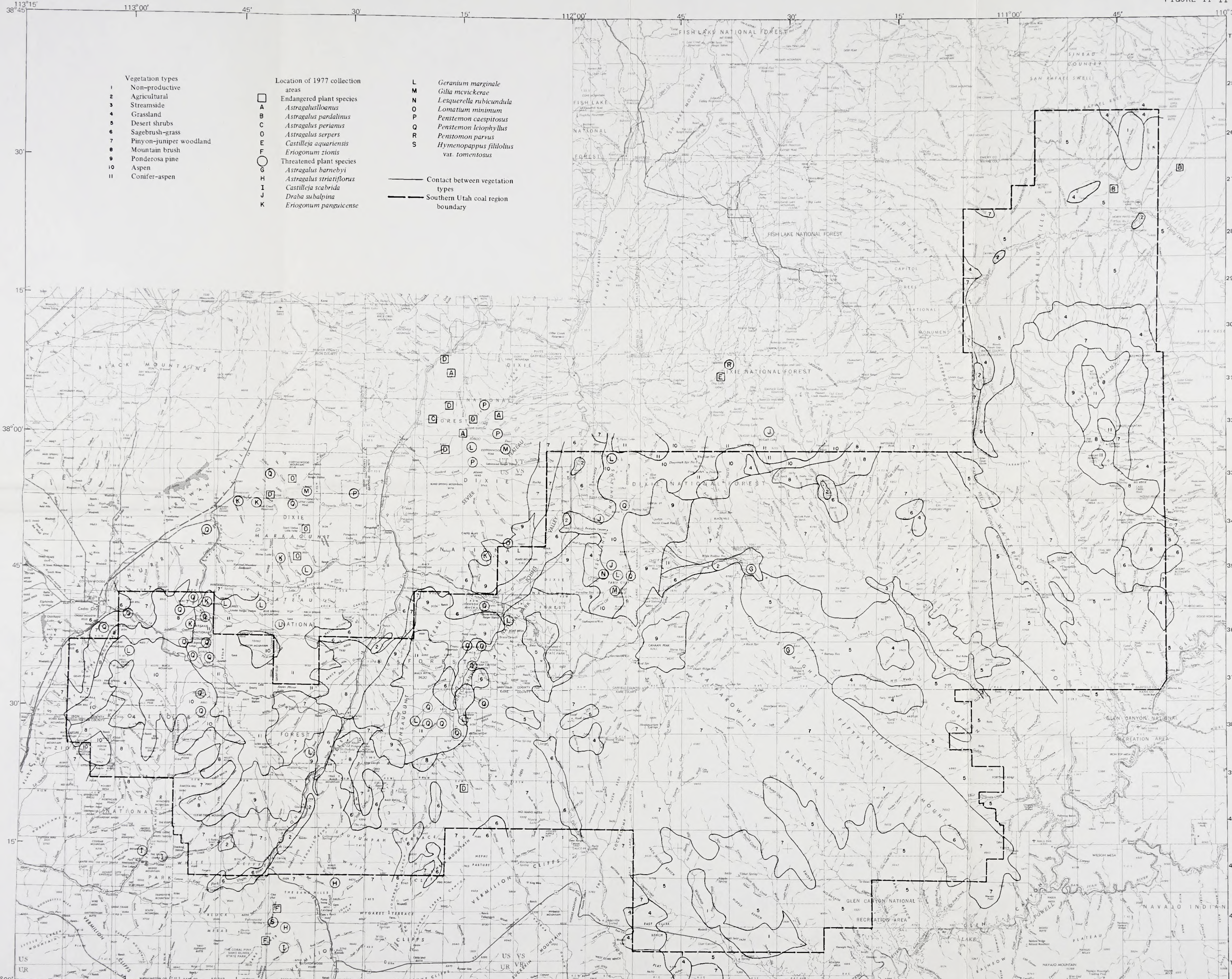
OWER'S CARD

OFFICE	DATE RETURNED

(Continued on reverse)

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

DRAFT EIS, SOUTHERN UTAH COAL
MINING AND RECLAMATION PLAN
FIGURE II-11



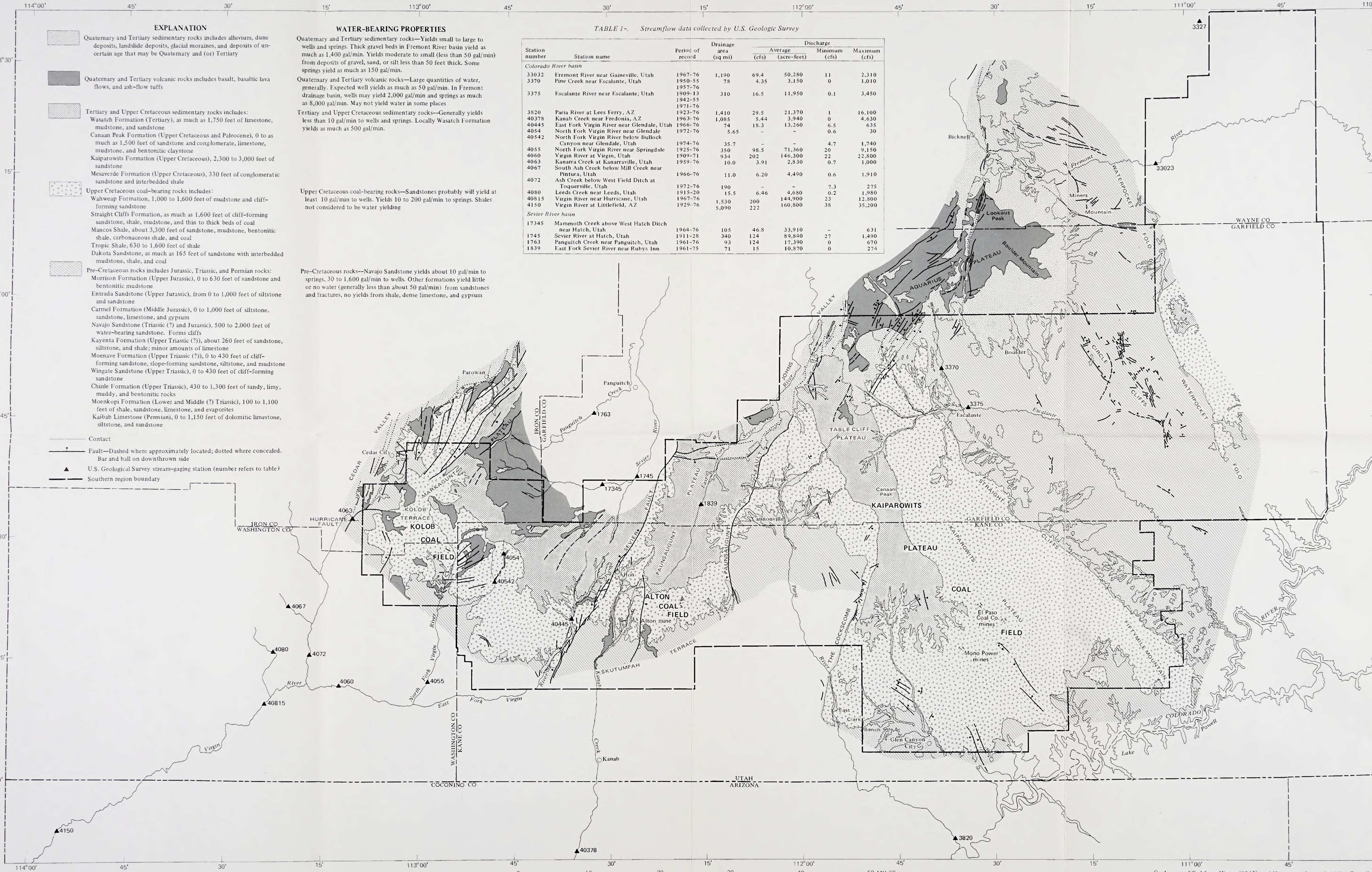
Base from U.S. Geological Survey
Escalante and Salina, 1956 revised 1970
Cedar City, 1953 revised 1971
Richfield, 1953 revised 1972 1:250,000

Modified from Foster, 1968; Hackman, 1973, and Smith, 1962

Figure II-11.--Distribution of vegetation types, endangered plants and threatened plants.

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

DRAFT EIS, SOUTHERN UTAH COAL
MINING AND RECLAMATION PLAN
FIGURE II-4



EXPLANATION

Quaternary and Tertiary sedimentary rocks includes alluvium, dune deposits, landslide deposits, glacial moraines, and deposits of uncertain age that may be Quaternary and (or) Tertiary

Quaternary and Tertiary volcanic rocks includes basalt, basaltic lava flows, and ash-flow tuffs

Tertiary and Upper Cretaceous sedimentary rocks includes:
- Wasatch Formation (Tertiary), as much as 1,750 feet of limestone, mudstone, and sandstone
- Canaan Peak Formation (Upper Cretaceous and Paleocene), 0 to as much as 1,500 feet of sandstone and conglomerate, limestone, mudstone, and bentonitic claystone
- Kaiparowits Formation (Upper Cretaceous), 2,300 to 3,000 feet of sandstone
- Mesaverde Formation (Upper Cretaceous), 330 feet of conglomeratic sandstone and interbedded shale

Upper Cretaceous coal-bearing rocks includes:
- Wahweap Formation, 1,000 to 1,600 feet of mudstone and cliff-forming sandstone
- Straight Cliffs Formation, as much as 1,600 feet of cliff-forming sandstone, shale, mudstone, and thin to thick beds of coal
- Mancos Shale, about 3,300 feet of sandstone, mudstone, bentonitic shale, carbonaceous shale, and coal
- Tropic Shale, 630 to 1,600 feet of shale
- Dakota Sandstone, as much as 165 feet of sandstone with interbedded mudstone, shale, and coal

Pre-Cretaceous rocks includes Jurassic, Triassic, and Permian rocks:
- Morrison Formation (Upper Jurassic), 0 to 630 feet of sandstone and bentonitic mudstone
- Entrada Sandstone (Upper Jurassic), from 0 to 1,000 feet of siltstone and sandstone
- Carmel Formation (Middle Jurassic), 0 to 1,000 feet of siltstone, sandstone, limestone, and gypsum
- Navajo Sandstone (Triassic (?) and Jurassic), 500 to 2,000 feet of water-bearing sandstone. Forms cliffs
- Kayenta Formation (Upper Triassic (?)), about 260 feet of sandstone, siltstone, and shale; minor amounts of limestone
- Moenave Formation (Upper Triassic (?)), 0 to 430 feet of cliff-forming sandstone, slope-forming sandstone, siltstone, and mudstone
- Wingate Sandstone (Upper Triassic), 0 to 430 feet of cliff-forming sandstone
- Chinle Formation (Upper Triassic), 430 to 1,300 feet of sandy, limy, muddy, and bentonitic rocks
- Moenkopi Formation (Lower and Middle (?) Triassic), 100 to 1,100 feet of shale, sandstone, limestone, and evaporites
- Kaibab Limestone (Permian), 0 to 1,150 feet of dolomitic limestone, siltstone, and sandstone

Contact

Fault—Dashed where approximately located; dotted where concealed. Bar and ball on downthrown side

▲ U.S. Geological Survey stream-gaging station (number refers to table)

Southern region boundary

WATER-BEARING PROPERTIES

Quaternary and Tertiary sedimentary rocks—Yields small to large to wells and springs. Thick gravel beds in Fremont River basin yield as much as 1,400 gal/min. Yields moderate to small (less than 50 gal/min) from deposits of gravel, sand, or silt less than 50 feet thick. Some springs yield as much as 150 gal/min.

Quaternary and Tertiary volcanic rocks—Large quantities of water, generally. Expected well yields as much as 50 gal/min. In Fremont drainage basin, wells may yield 2,000 gal/min and springs as much as 8,000 gal/min. May not yield water in some places

Tertiary and Upper Cretaceous sedimentary rocks--Generally yields less than 10 gal/min to wells and springs. Locally Wasatch Formation yields as much as 500 gal/min.

Upper Cretaceous coal-bearing rocks—Sandstones probably will yield at least 10 gal/min to wells. Yields 10 to 200 gal/min to springs. Shales not considered to be water yielding

Pre-Cretaceous rocks--Navajo Sandstone yields about 10 gal/min to springs, 30 to 1,600 gal/min to wells. Other formations yield little or no water (generally less than about 50 gal/min) from sandstones and fractures, no yields from shale, dense limestone, and gypsum

TABLE 1-. Streamflow data collected by U.S. Geologic Survey

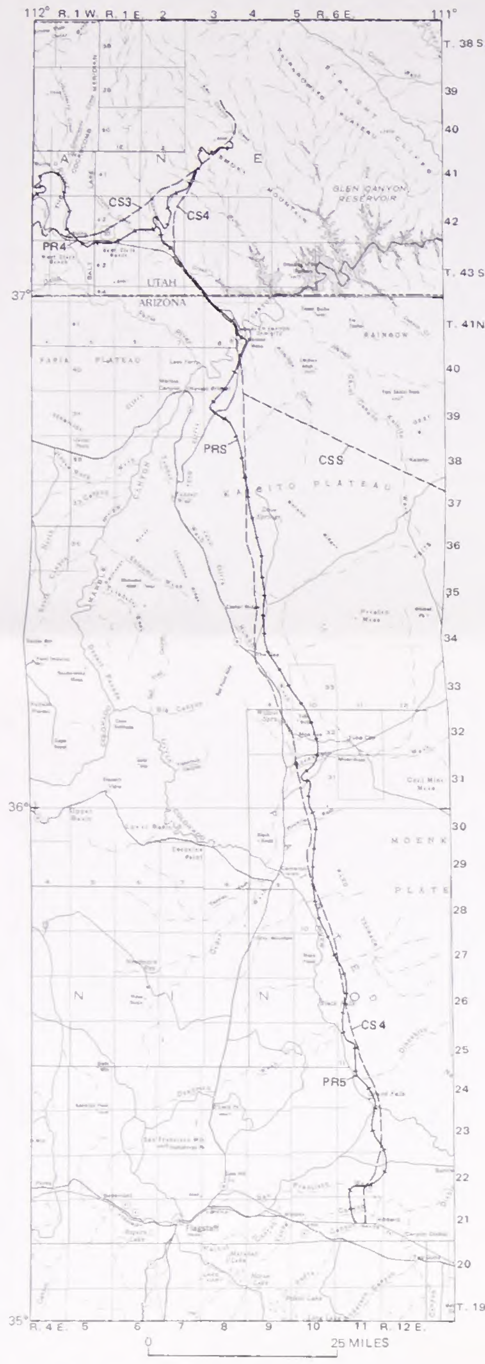
Station number	Station name	Period of record	Drainage area (sq mi)	Discharge: Average (cfs)	Discharge: Average (acre-feet)	Discharge: Minimum (cfs)	Discharge: Maximum (cfs)
Colorado River basin							
33032	Fremont River near Gaineville, Utah	1967-76	1,190	69.4	50,280	11	2,310
3370	Pine Creek near Escalante, Utah	1950-55 1957-76	78	4.35	3,150	0	1,010
3375	Escalante River near Escalante; Utah	1909-13 1942-55 1971-76	310	16.5	11,950	0.1	3,450
3820	Paria River at Lees Ferry, AZ	1923-76	1,410	29.5	21,370	1	16,100
40378	Kanab Creek near Fredonia, AZ	1963-76	1,085	5.44	3,940	0	4,630
40445	East Fork Virgin River near Glendale, Utah	1966-76	74	18.3	13,260	6.5	635
4054	North Fork Virgin River near Glendale	1972-76	5.65	-	-	0.6	30
40542	North Fork Virgin River below Bullock Canyon near Glendale, Utah	1974-76	35.7	-	-	4.7	1,740
4055	North Fork Virgin River near Springdale	1925-76	350	98.5	71,360	20	9,150
4060	Virgin River at Virgin, Utah	1909-71	934	202	146,300	22	22,800
4063	Kanarra Creek at Kanarraville, Utah	1959-76	10.0	3.91	2,830	0.7	1,000
4067	South Ash Creek below Mill Creek near Pintura, Utah	1966-76	11.0	6.20	4,490	0.6	1,910
4072	Ash Creek below West Field Ditch at Toquerville, Utah	1972-76	190	-	-	7.3	275
4080	Leeds Creek near Leeds, Utah	1915-20	15.5	6.46	4,680	0.2	1,980
40815	Virgin River near Hurricane, Utah	1967-76	1,530	200	144,900	23	12,800
4150	Virgin River at Littlefield, AZ	1929-76	5,090	222	160,800	38	35,200
Sevier River basin							
17345	Mammoth Creek above West Hatch Ditch near Hatch, Utah	1964-76	105	46.8	33,910	-	631
1745	Sevier River at Hatch, Utah	1911-28	340	124	89,840	27	1,490
1763	Panguitch Creek near Panguitch, Utah	1961-76	93	124	17,390	0	670
1839	East Fork Sevier River near Rubys Inn	1961-75	71	15	10,870	0	274

Figure II-4.--Generalized Geological-Hydrologic Map of Coal Areas of South-Central Utah.

Geology modified from Hintze (1963) and Hintze and Stokes (1964). Compiled by K. A. Sargent, 1976. Adapted and modified from Sargent and Hansen, 1976

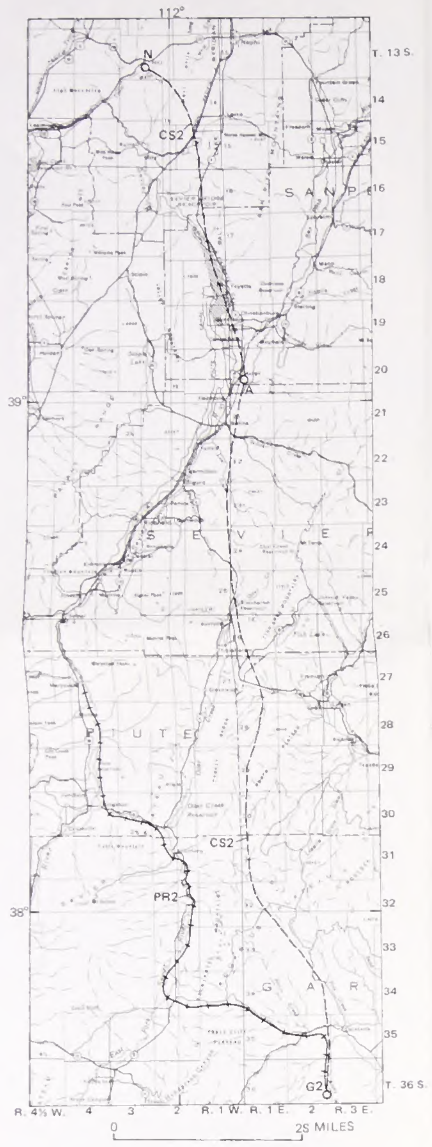
UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

DRAFT EIS, SOUTHERN UTAH COAL
MINING AND RECLAMATION PLAN
FIGURE I-2



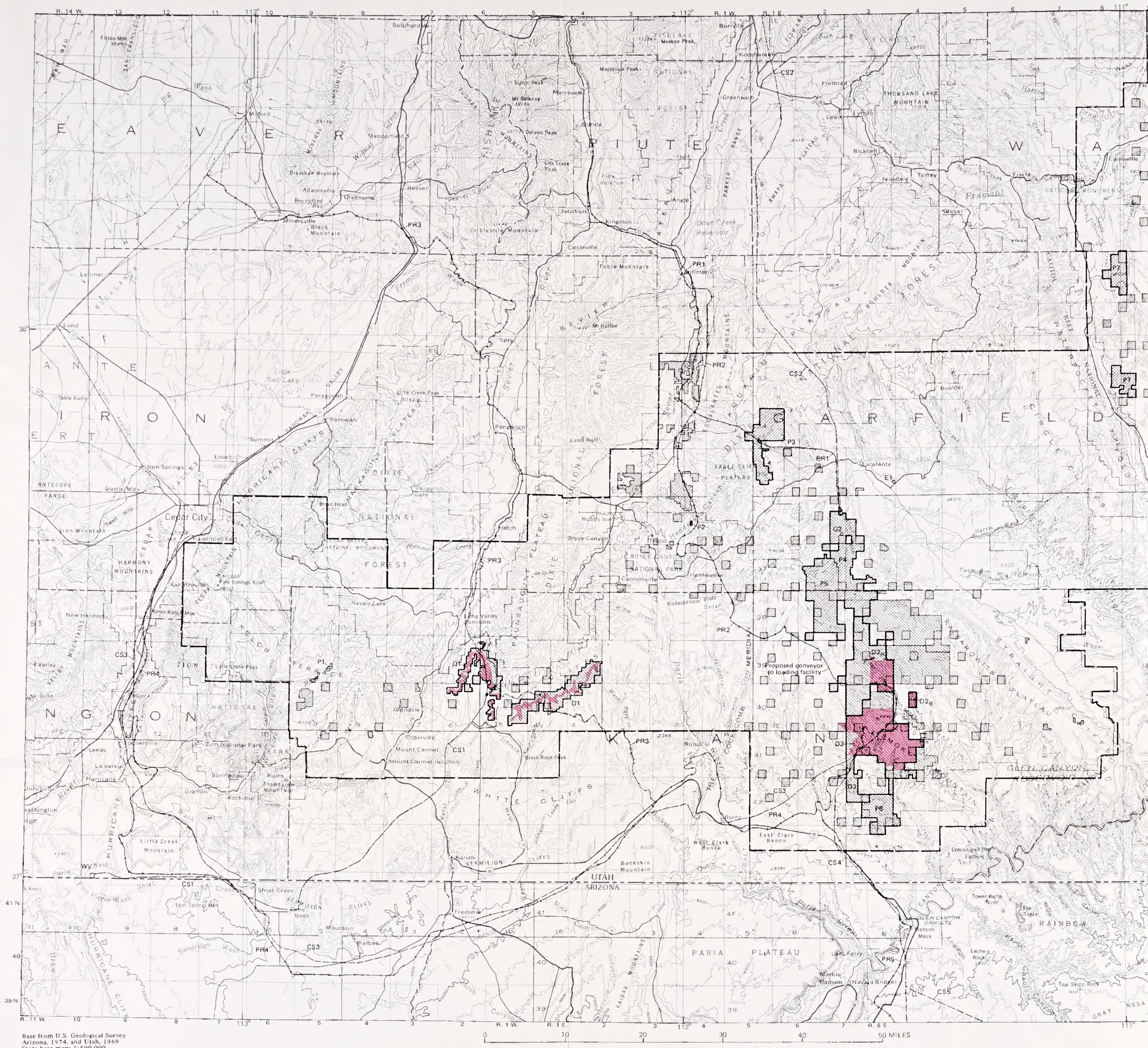
Base from U.S. Geological Survey Arizona, 1974, and Utah, 1969 State base maps 1:500,000

Proposed coal-slurry pipeline route (CS4) and proposed Santa Fe railroad (PR5) to Flagstaff, Arizona.



Base from U.S. Geological Survey State base map 1:500,000, 1969

Proposed coal-slurry pipeline route (CS2) to Axtell (A) and Nephi (N) generating stations and proposed Denver and Rio Grande railroad (PR2) to Marysvale, Utah.



Base from U.S. Geological Survey Arizona, 1974, and Utah, 1969 State base maps 1:500,000 Roads as of 1978

Map showing locations of Federal and State coal leases, all existing mines, proposed mines, coal-fired generating stations, coal haul railroads, and coal-slurry pipelines routes.

Coal leases
- Existing leases on Federal lands
- Preference Right Lease Applications (PRLA) on Federal lands
- Existing leases on State lands

Proposed mining areas

Detailed mining proposals

D1	Nevada Power Co., Utah International, Inc., Alton coal-strip mine
D2	El Paso Energy Resources Co., Red(R) and Blue(B) mines
D3	Mono Power, et al, Kaiparowits 1, 2, 3, 4, and 5 mines

Preliminary mining proposals

P1	King Cannel Coal Co., Kane County
P2	Fulton and Denton, Shakespeare mine
P3	Woods Petroleum Corp., White Mountain mine
P4	Utah Power and Light Co., Garfield County
P5	Sunoco Energy Development Co., Right Hand Collet Canyon
P6	Hiko Bell Mining and Oil Co. and AU Mines, Inc., South Nipple Butte mine
P7	Meadowlark Farms, Inc., Garfield County

Detailed powerplant proposal

WV	Nevada Power Co., et al, Warner Valley generating station

Preliminary powerplant proposal

E1	U.P.B. Escalante generating station
G2	Utah Power and Light Co., alternate Garfield generating station

Detailed coal slurry pipeline proposal

CS1	Nevada Power Co., et al, to Warner Valley and Harry Allen generating stations

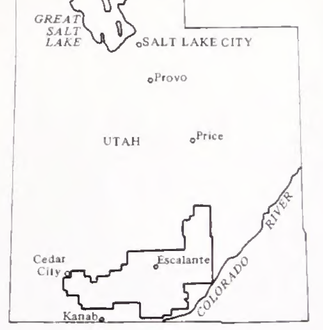
Preliminary coal slurry pipeline proposals as alternatives to railroads

CS2	Utah Power and Light Co. to Nephi, Utah
CS3	El Paso Energy Resources Co. to Cedar City, Utah
CS4	El Paso Energy Resources Co. to Flagstaff, Arizona
CS5	El Paso Energy Resources Co. To Walsenburg, Colorado

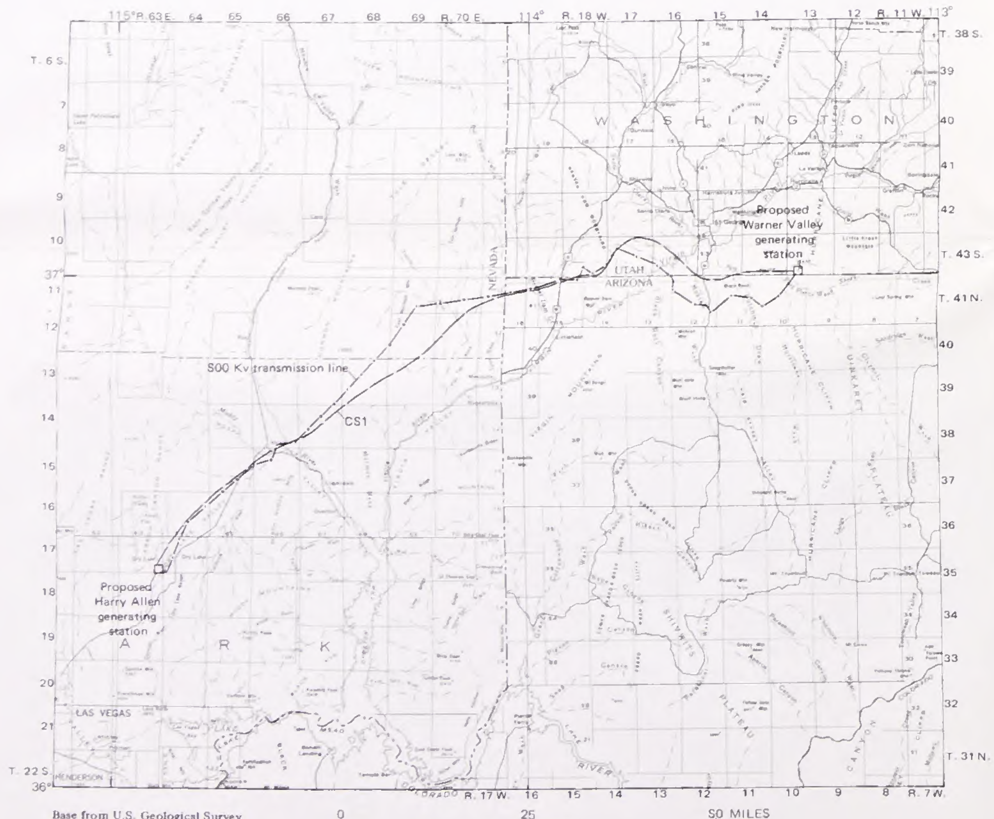
Preliminary railroad proposals

PR1	Utah Power and Light Co. to Marysvale, Utah
PR2	Denver and Rio Grande Railroad to Marysvale, Utah
PR3	Union Pacific Railroad to Milford, Utah
PR4	Union Pacific Railroad to Cedar City, Utah
PR5	Santa Fe Railroad to Flagstaff, Arizona

Southern region boundary

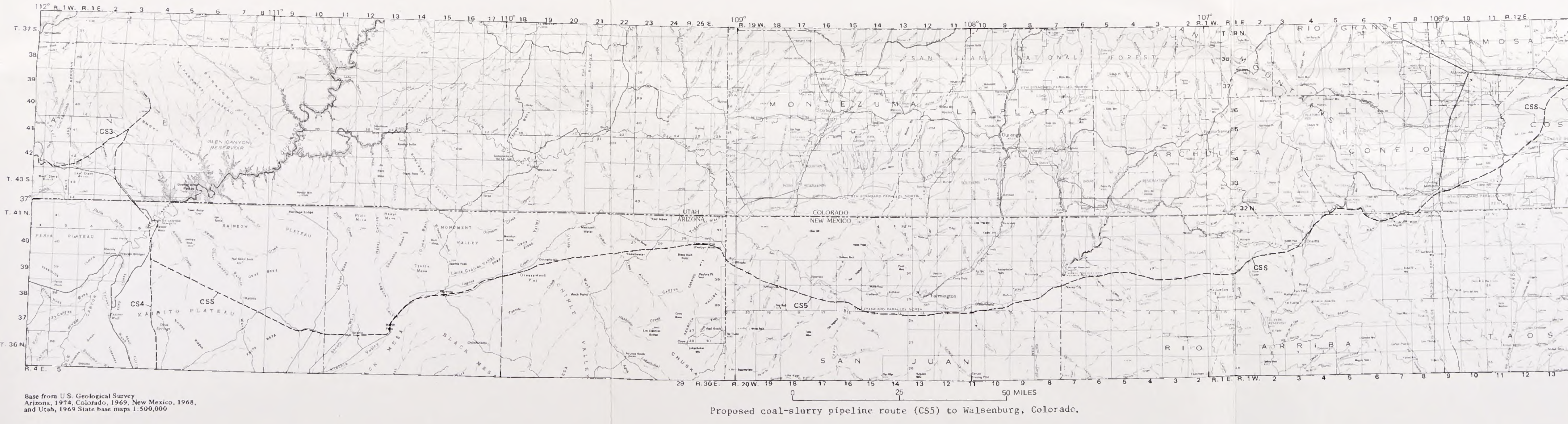


Index map showing location of the southern Utah coal region.



Base from U.S. Geological Survey Arizona, 1974, Nevada, 1965, and Utah, 1969 State base maps 1:500,000

Coal-slurry pipeline route (CS1) and 500 kV transmission line from Warner Valley to Harry Allen generating stations.



Base from U.S. Geological Survey Arizona, 1974, Colorado, 1969, New Mexico, 1968, and Utah, 1969 State base maps 1:500,000

Proposed coal-slurry pipeline route (CS5) to Walsenburg, Colorado.

Figure I-2.--MAPS OF SOUTHERN UTAH COAL REGION AND ADJACENT STATES SHOWING LOCATION OF COAL DEVELOPMENT AND COAL-ASSOCIATED PROPOSALS.

UNITED STATES DEPARTMENT OF THE INTERIOR
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KOLOB AND ALTON COAL FIELDS

Coal reserve, in millions of short tons[1]

	AREA	COAL CLASSES[2] I, II	II	III	III, IV	IV	SUBTOTALS (BY AREA)
KOLOB FIELD	1					8.1	8.1
	2			23.4			23.4
	3		28.1				28.1
	4		5.4				5.4
	5			43.4			43.4
	6				265.3		265.3
	7	63.6		10.7			74.3
	8	55.7		15.7			71.4
	9	55.4					55.4
	10	27.9					27.9
	11			19.95			19.95
	12					7.82	7.82
	13			11.15			11.15
	14			55.74			55.74
	15			30.86			30.86
	16			81.73			81.73
	17			16.7			16.7
	18			4.38			4.38
	19		3.06				3.06
	20	85.67					85.67
	21	20.92					20.92
	22			45.38			45.38
	23	48.33					48.33
	24	189.80		207.83			397.63
	25		99.53	461.65			561.18
	26A, 26B	Area of potential but thickness of cover most probably exceeds 3,000 feet (approximately the area underlain by Tertiary rocks)					
ALTON FIELD	27	Area of potential coal but data insufficient to calculate quantity					
	28	Area of potential coal where thickness of cover over coal exceeds 3,000 feet					
	29A, 29B, 29C					278.7	278.7
	30					197.11	197.11
	31		102.42	418.19			520.61
	32		135.24[3]				135.24
	33[4]						296.67
	34		135.82	189.58		78.99	404.39
	35	Some coal possible, data insufficient to calculate quantity					
	36	Some coal possible, data insufficient to calculate quantity					
	37		71.01	48.62		12.44	132.07
		(Data insufficient to calculate other possible coal reserve)					
	38		54.05				54.05
	39		2.97	54.72		72.32	130.01
	40	Coal present, but Doelling and Graham (1972a, p. 40) consider it to be substandard					
	41	No potentially mineable coal					
	42	Data insufficient					
	43	Little or no potentially mineable coal					
	44	Data insufficient to calculate					
COAL, BY CLASS, IN MILLIONS OF TONS		547.3	637.6	1,739.7	265.3	655.5	TOTAL COAL, ALL CLASSES 4,142.1

[1] Sources of data: Doelling and Graham, 1972, and Cashion, 1961.
[2] Coal classes used here are generally the same as used by Doelling and Graham (1972), see explanation.
[3] Coal under less than 1,000 feet overburden.
[4] Unclassified.

REFERENCES

Cashion, W. B., 1961, Geology and fuel resources of the Orderville–Glendale area, Kane County, Utah: U.S. Geol. Survey Coal Investigations Map C–49.

Doelling, H. H., 1970, Coal in Utah—1970, in Doelling, H. H., Central Utah coal fields: Sevier–Sanpete, Wasatch Plateau, Book Cliffs and Emery, 571 p. (see especially p. 549).

Doelling, H. H., and Graham, R. L., 1972, Southwestern Utah coal fields: Alton, Kaiparowits Plateau and Kolob–Harmony; Monograph Series No. 1: Utah Geol. and Mineralogical Survey, 333 p.

Federal ownership of mineral rights

State and private ownership of mineral rights

Coal, potentially mineable, reserve for area shown in tables

Coal outcrop, dashed where concealed, uncertain, or approximately located; stippled pattern behind outcrop

Inferred limit of potentially mineable coal, generally based on thickness or, locally, on other data, such as limits of burned coal; dashed where uncertain or approximately located

Other boundary between reserve areas, such as political, available data, etc.

3,000-foot depth of potentially mineable coal

Fault, dashed where concealed or approximately located

Volcanic vent, potentially mineable coal possibly absent

COAL CLASSES[1]

Class I — *Measured reserves* based on adequate exploration data; properly correlated; control no more than one-half mile apart.

Class II — *Indicated reserves* based on geologic measurement supplemented by limited drill-hole information and limited to 1½ miles from a control point.

Class III — *Inferred reserves* based on geologic inference and projection of the habit of the coal beyond 1½ miles from control points.

Class IV — *Potential reserves* based on geographic and geologic position with little surrounding data; includes coal covered by no more than 3,000 feet of overburden.

Most of the coal reserve is based on surface measurements which are not always as reliable as the drill. The reserve commonly is underestimated because surface measurements usually are smaller than thickness penetrated by drilling. Class I and II figures are combined in these reports; no attempt was made to separate the more reliable figure. The first three reserve classes constitute the principal reserve and more nearly reflect the current potential. The reserves include only coal beds that average 4 feet or greater thickness and are covered by less than 3,000 feet of overburden except where otherwise noted. Less than 50 percent of the total reserves are economically mineable.

[1] The division of coal into four classes generally follows that described by Doelling (1972c, p. 549).

KAIPAROWITS PLATEAU COAL FIELD

Preliminary estimate: 20,000,000,000 short tons coal beds 4 feet or more thick; overburden no thicker than 3,000 feet.

HENRY MOUNTAINS COAL FIELD

Coal reserve, in millions of short tons[1]

AREA	COAL CLASSES I, II	III	IV	
45	4.08			
46	41.0			
47	5.9			
48	28.0			
49	Insufficient data to calculate quantity			
50		19.1		
51	24.3			
52			21.74	
53			28.32	
54			72.89	
55			17.0	
56	11.8			
57	0.7			
58			33.45	
59	4.29			
60	4.61			
61	1.58			
62	30.87			
63	4.79			
64	9.48			
65	0.15			
66	11.99			
67	17.69			
68	15.05			
69	4.2			
70	0.84			
71	22.75			
COAL, BY CLASS, IN MILLIONS OF TONS	244.07[2]	19.1[2]	173.40	TOTAL COAL, ALL CLASSES 436.57

[1] Sources of data: Doelling and Graham, 1972, and Doelling, 1975.
[2] We obtained a total cover coal reserve of 263.17×10^6 short tons, class I through III deposits, based on data given by Doelling and Graham (1972), where a total of 230.9×10^6 short tons was cited, and which total should be amended upward based on Doelling's (1975) subsequent total of 248.7×10^6 short tons for that part of the bicounty Henry Mountains Coal Field lying in Garfield County, Utah. These figures include beds of 4 feet or greater thickness and exclude potential reserves (class IV deposits). Doelling and Graham (1972) stated that one-third of the estimated class I through III resource is under less than one hundred feet of overburden, and almost all is under less than two hundred feet of overburden. Therefore, some of the coal could be strip-mined. Also, it might be feasible during stripping to mine some of the adjacent coal in rider beds less than four feet in thickness and which are not included in the reserves estimates given above. The additional reserve of thinner coal beds totals several hundred million short tons (Doelling, 1972), of which an unidentified portion might be amenable to mining in the context stated above.

REFERENCES

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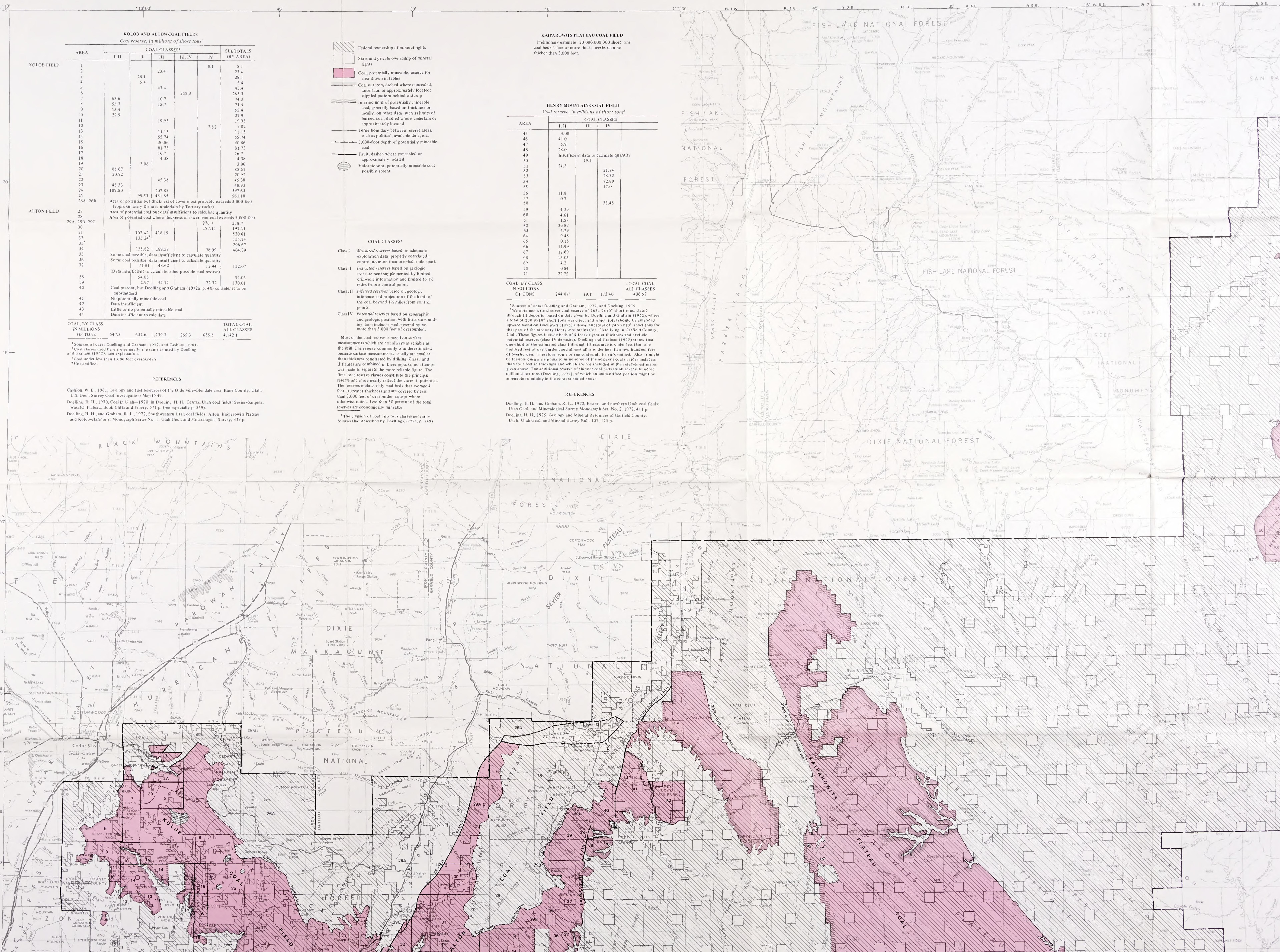

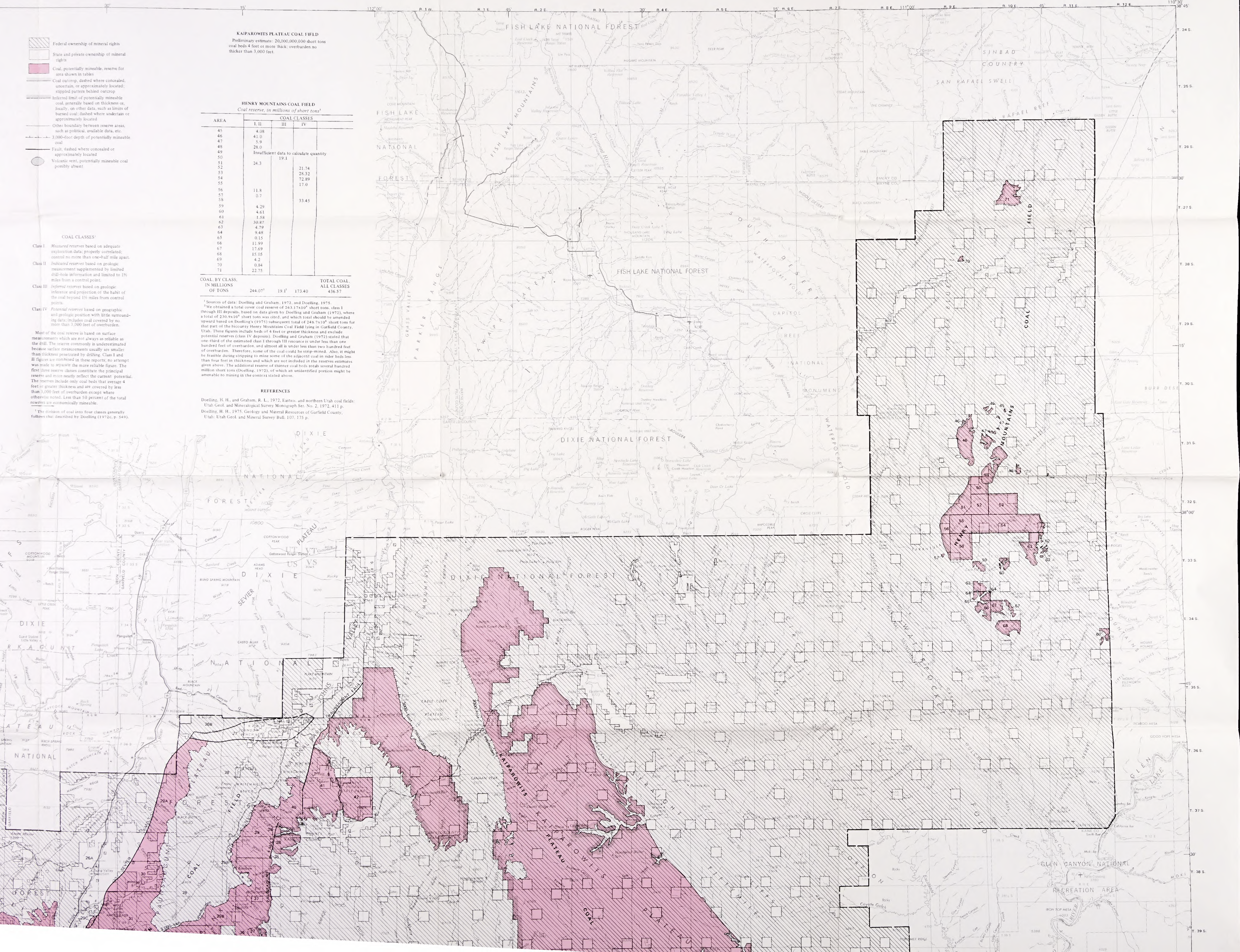

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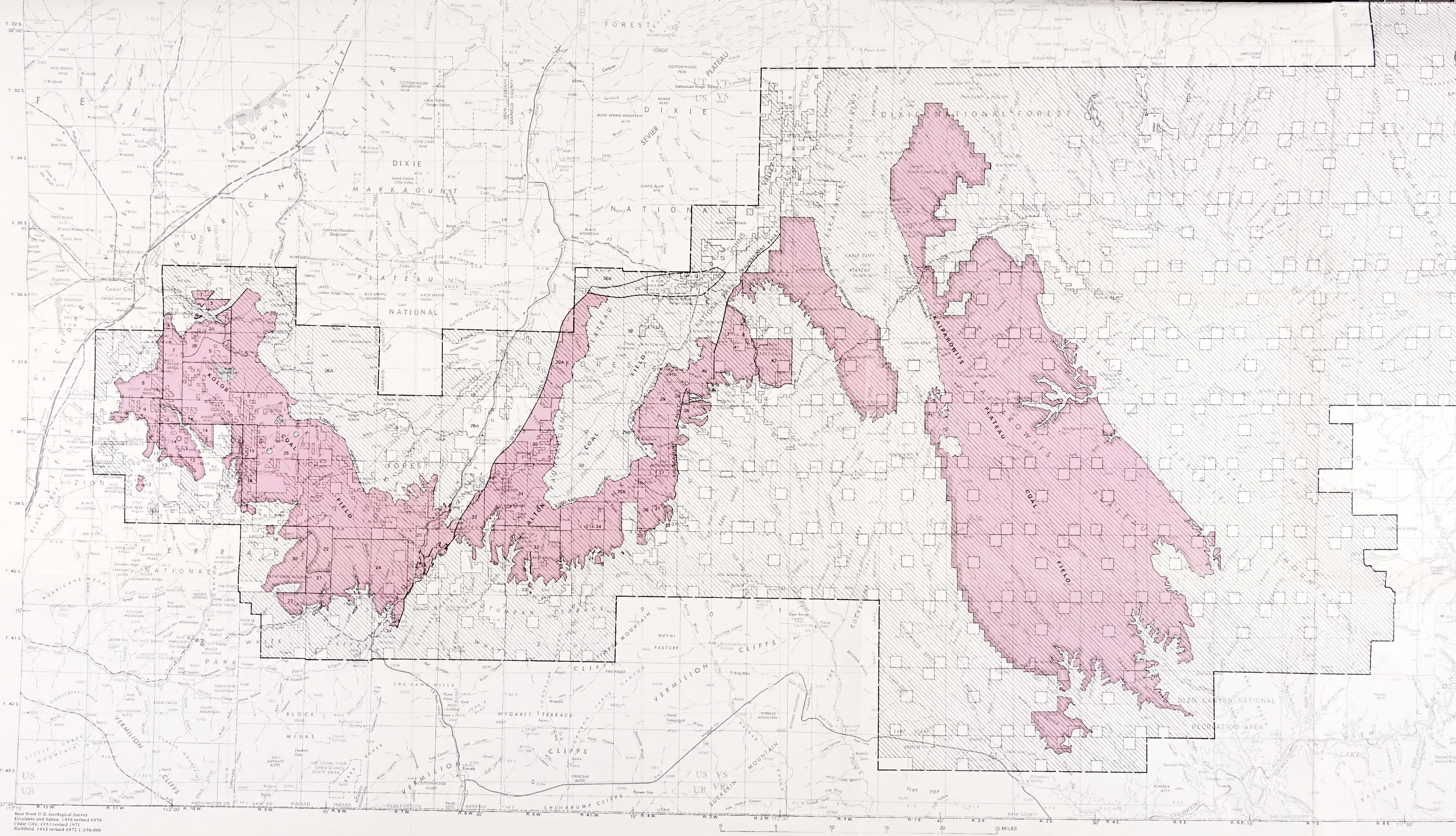
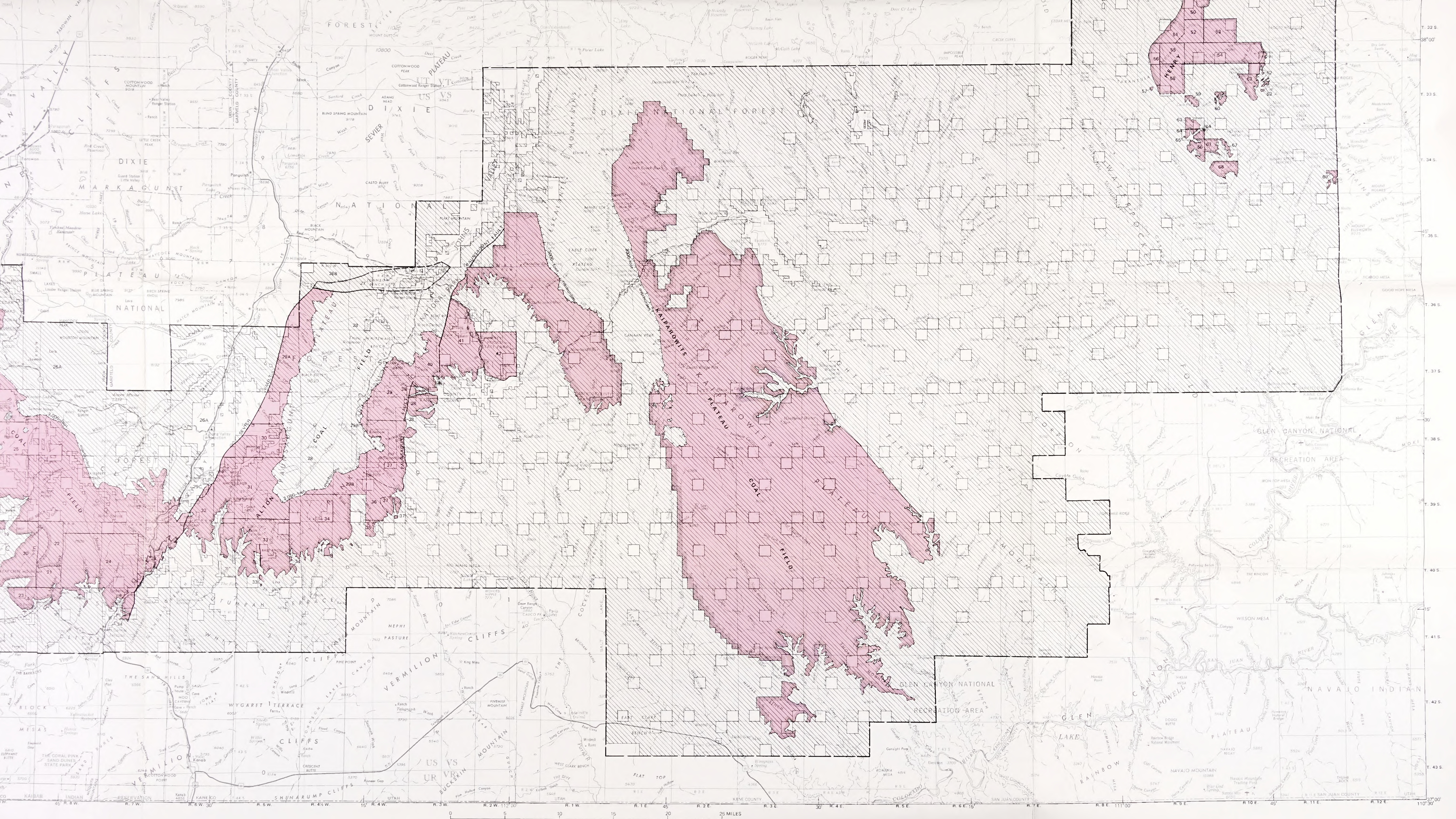


Base from U.S. Geological Survey
Escalante and Salina, 1956 revised 1970
Cedar City, 1953 revised 1971
Richfield, 1953 revised 1972 1:250,000

Figure II-6.--Coal reserves by area.



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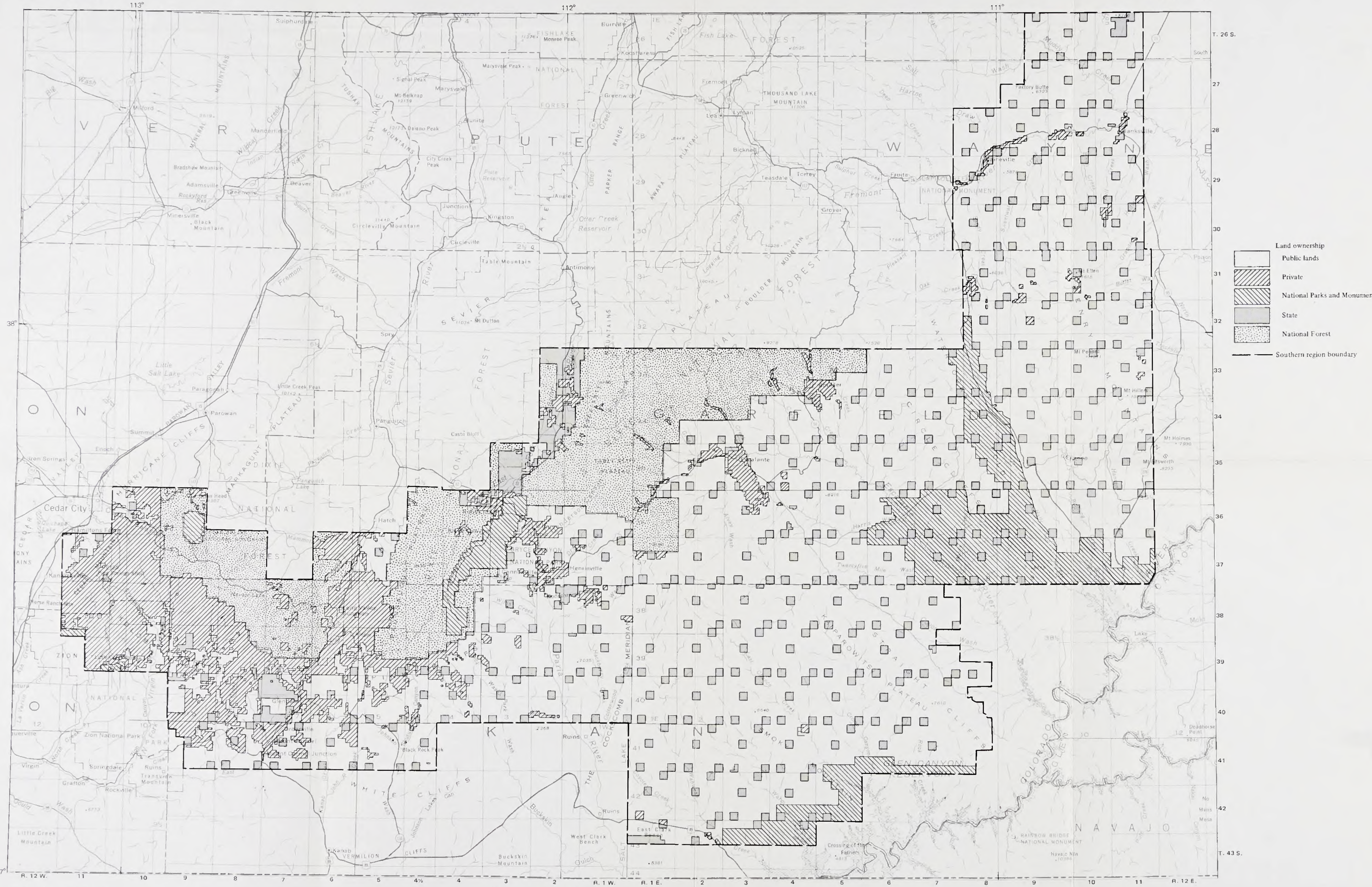

0 10 20 30 40 50 MILES

Base from U.S. Geological Survey
State base map 1:500,000, 1969
Roads as of 1978

Figure II-16.--Map of Southern Utah Coal Region showing land ownerships.

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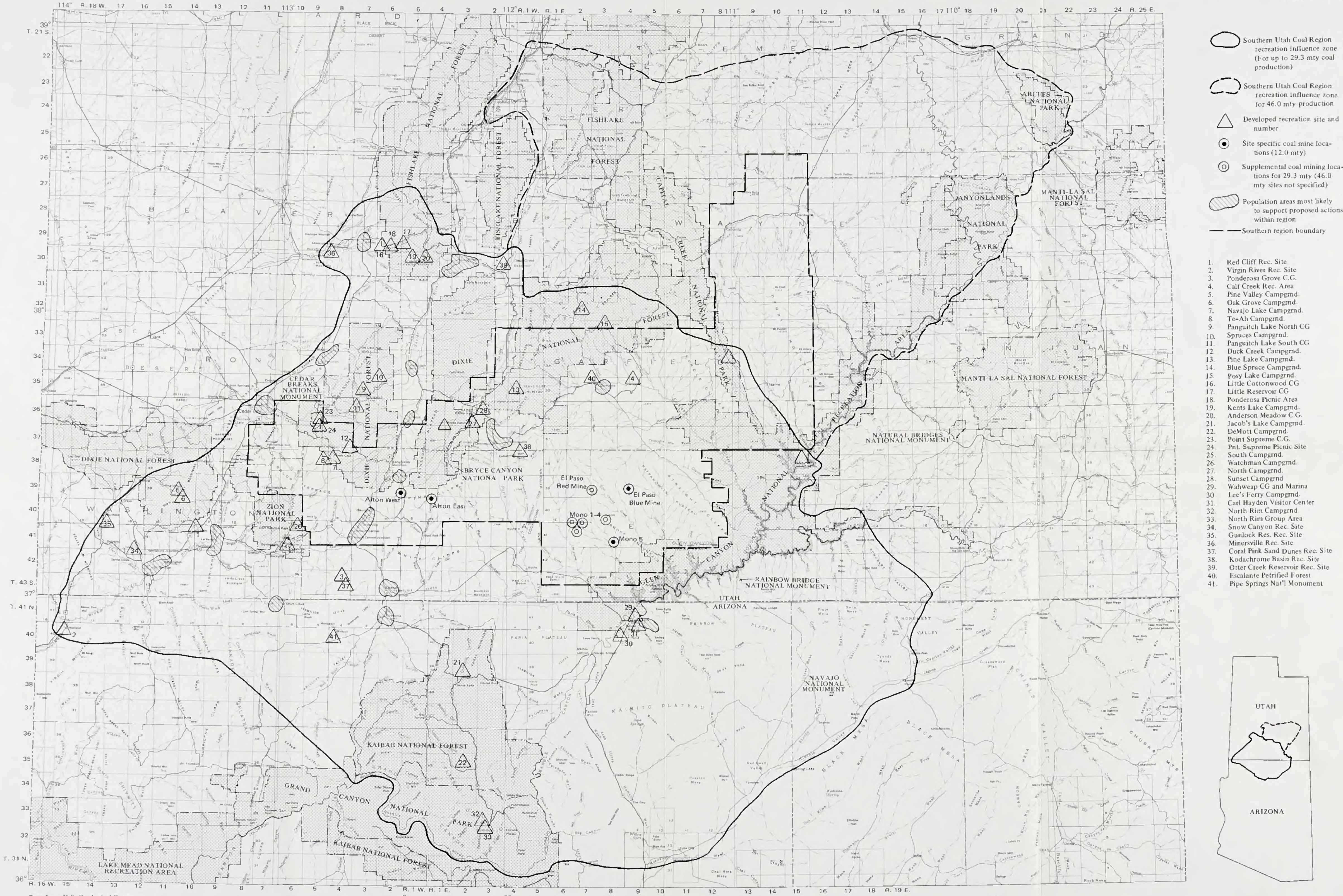

Base from U.S. Geological Survey
Arizona, 1974, and Utah, 1969
State base maps 1:500,000

Figure II-21.--Recreation Influence Zone.